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THE NATIVE RUBBERS OF THE MALAY PENINSULA.

There are upwards of a hundred different plants belonging to several orders which have been recorded as producing rubber. Many of these, however, are really but little known commercially, and a considerable number have been practically condemned as commercially of no value, either from the inferiority of the product or from the small quantity produced.

This verdict will probably be reversed in some cases when we are more familiar with the best methods of extracting rubber, and of treating it. Hitherto rubber has been derived almost exclusively from the wild plants, lately it has come under the hands of the planter, and though, as a rule in cultivation of any product, one plant is found to be commercially the most suitable to cultivate in most places, still there are localities and conditions in which other plants may be preferable, or of value as accessory.

Although many works have been written lately upon the various kinds of rubbers commonly known, I observe that little or nothing has been recorded as to our local rubber vines and rubber trees, and there is much confusion about them. The wild rubber plants of the peninsula belong to the orders of *Urticaceæ* and *Apocynaceæ*. Of the former we have several species of *Ficus*, of which besides the well-known Getah Rambong, *Ficus elastica*, we have in our forests also *Ficus annulata* Bl. *F. altissima* Bl. and *F. obtusifolia* Roxb., all stated to produce rubber, but I have failed to get any from the first two. There are also the *Artocarpi*, *A. integrifolia*, the Jack, and *A. Kunstleri* King, Getah Terap. These latter undoubtedly contain a caoutchouc, but it does not set sufficiently well, by ordinary methods of treatment to be commercially valuable. It remains sticky and in some cases semi-liquid, and is chiefly used by the Malays as bird-lime for which it is very well adapted.

The order Apocynaceæ supplies the Rubber vines and the Rubber trees Dyera and Alstonia.

The rubber vines as rubber producers seem to have been very much confused, owing perhaps to the Malays using the same name for several distinct species, and also in some cases from writers guessing at the plants which produced a special rubber. The market names too are very much confused; such names, for instance, as Borneo rubber or Java rubber, have been very loosely used and the name Gutta Susu has been applied to Willughbeias and Urceolas impartially. The words Getah Grip or Grit, Gegrip, Gegrit and in Borneo Singarip, are applied to almost any rubber vine whether a *Willughbeia*, *Urceola* or *Parameria*, and may be taken as simply meaning rubber vine as opposed to a rubber tree. Serapit is another word applied to very various

rubbers. In the Peninsula it usually means *Parameria polyneura* or *P. glandulifera*, but it is also used for a *Hoya* which does not produce rubber. In Borneo it is applied to a species of *Willughbeia* or *Leuconotis*. The Borneo rubber vines are at present very little known. Burbidge collected and made drawings of them when in British North Borneo, and some account of these was published in the Kew Bulletin for 1880, of which work I have been unable to procure a copy. A considerable amount of rubber is exported from Borneo, and it would be very desirable to obtain specimens of the plants producing it.

Some of the recent works on caoutchouc state that the asclepiadaceous plants, *Calotropis procera* and *C. gigantea* supply part of the Borneo rubber. This I doubt very much, but if so, the amount supplied must be very small, as these plants are by no means abundant in this region, and thrive but indifferently, the climate being too wet for them. *Cynanchum ovalifolium* has also been stated to produce a local rubber, but this appears to have originated in a mistake. The climbing *Asclepiadaceæ* may certainly contain caoutchouc in their latex, but their stems are so slender and the amount that they produce comparatively so small that they would hardly be worth cultivating for this purpose.

Among the Apocynaceæ we have a number of rubber vines producing rubbers of considerable value and which have long been in use, besides two or three trees. The following is a list of the species :—

RUBBER VINES.

Flowers in short axillary cymes, fruit a berry often large.

Willughbeia firma, Bl. Flowers white, fruit globose, soft.
W. coriacea, Wall. ,, ,, oblong.
W. tenuiflora, Dyer. ,, ,, ovoid.
W. flavescens, Dyer. Flower yellowish, fruit globular.
Melodinus orientalis, Bl. Flowers white, fruit with a hard rind.
M. coriaceus, Oliv. ,, ,, ,,
Chilocarpus enervis, Hook. fil. Flowers orange, fruit splitting in two.
Leuconotis eugeniifolius, Wall. Flowers orange, fruit pear-shaped.
L. Griffithii, Hook. fil. Flowers orange.
L. Maingayi, Dyer. ,, ,,

Flowers in panicles, terminal or axillary. Fruit a capsule with plumed seeds :

Parameria glandulifera, Benth. Flowers pink.
P. polyneura, Hook. fil. Flowers pink or white.
Urceola elastica, Roxb. Flowers green very small.
U. lucida, Benth. ,, ,,
U. Malaccensis, Hook. fil. ,, ,,
U. Maingayi, Hook. fil. ,, ,,
U. brachysepala. Hook. fil. ,, ,,
U. torulosa, Hook. fil. ,, ,,

Trees:

Dyera laxiflora, Hook. fil. and *D. costulata*, Hook. fil. } Pods very large and woody, seeds flat with a thin wing.

Alstonia scholaris, Br. Pods slender, seeds plumed.

WILLUGHBEIA.

W. firma, Bl.—A large climber about 4 inches through. Bark thick black covered with brown warts, in section red. Branches black warted, tendrils long and slender on the ends of the branches. Leaves coriaceous, dark shining green, lanceolate, acute, 4 inches long by 1½ wide, petiole thick, nearly ½ inch long, nerves about 10 to 15 pairs. Flowers in short axillary cymes, about as long as the petiole on stout peduncles, white sweet-scented, pedicels very short and thick. Bracts ovate, lanceolate as long as the pedicel. Calyx ⅛ inch long, lobes 5, rounded ciliate on the edge. Corolla more than twice as long, tube dilated about the middle. Anthers 5, ovate acute, filaments very short, half-way down the tube adnate to the sides. Ovary globose style shorter than the calyx, stigma conic. Fruit rounded, oblong or globose, about 4 inches long and 4 inches through, dull green or orange coloured, seeds numerous, soft, oblong, flat, inch 1 long, ¼ inch wide, and rather more than ⅛ inch thick, with violet testa, cotyledons tinted violet.

Common in the Malay Peninsula from Singapore to Malacca, Penang and Perak, also Sumatra (Lampong) and Borneo.

Natives names, Getah grip, gegrip, grit, gegrit, or singarip putih besih and merah; Cherit morai and Manungan pulau in Borneo.

This is perhaps the best of all the Getah grips, and is the most sought after. It grows readily from seed, though not very fast, having a habit of making long slender twiggy stems, especially if grown in the open. In forests it climbs to the tops of the highest trees, and the stem eventually becomes very thick. It is distinguished from *W. coriacea*, by the longer leaves with more nerves, longer peduncles and cyme, larger calyces.

The first account of the collecting of rubber from this plant is that of MURTON, who published it in the Kew Report of 1880, p. 46, which is long out of print and unprocurable, but extracts from it are printed in MORRIS' Cantor Lecture, p. 43. MURTON mentions two varieties. One he describes as having dark bark with lighter coloured warts, is the true plant. The other with light cork coloured bark is certainly something else, probably Leuconotis. His account of the collecting is as follows:—"The stem is ringed at intervals of 10 to 12 inches, and the milk allowed to run into vessels made of palm leaves, cocoanut shells, or anything available for the purpose; it continues to flow for a time, but after flowing for ten minutes it becomes watery and thin, one plant will yield from 5 to 10 catties of the coagulated caoutchouc; when raw, it has the appearance of sour milk, and to coagulate it the natives add salt or salt water. When freshly coagulated it is quite white, which gradually changes to a darker colour. It keeps white inside and, on cutting, produces

a foveated appearance, the cells containing water and salt, which have become enclosed during coagulation. In texture it is very soft, spongy and very wet."

It is commonly stated also that the natives use urine to set the rubber.

Another account of this plant has recently been published by Messrs. VIVIER and DEISS in the Bulletin Economique de l'Indo-Chine, No. 14, August 1899, which commences with a translation of MURTON's description of the plant and its two supposed varieties, without, however, any acknowledgment of the source of this information. The authors, after describing the method and difficulties of cutting down the liane and the ringing of the bark, collecting the latex in bamboos and coagulating with salt or boiling, state that a pound or a pound-and a-half is obtained from one liane, and proceed to give an estimate as to the returns which may be expected from a plantation in the following terms :—

"Le reproduction de cette liane est facile. Elle laisse loin derriére elle au point de vue de la vigueur et de la croissance toutes les autres sortes. Plantée dans un terrain defriché elle forme au bout d'un an une brousse epaisse. Les resultats de croissance de vigueur et de rendement rationnel du Willughbeia sembleraient demontrer qu'il est preferable d'en faire des plantations plutot que de chercher à acclimater des arbres étrangers qui demand nt quinze ans et au de la avant de pouvoir donner leurs premiers resultats, toujours douteux dans de nouveaux habitats. Une plantation de 500 acres dans laquelle on planterait 100,000 Willughbeia reviendrait a la fin de la 2e annee, c'est a dire a l'epoque ou l'on pourrait l'exploiter a soixante-quinze mille francs environ. Le rendement doit estimé a 1 kilogramme par pied. Le prix de cette sorte de caoutchouc est de 6 francs 25 a 6 *fr.* 50 en Europe par kilogramme."

I am certainly quite unable to endorse the statements as to the rapidity of growth of Willughbeia. Raised either from seed or cutting, it takes a good deal more than one year to form a thick bush. Plants grown in the Botanic Gardens for about six or seven years have indeed made low bushes with very slender stems, while plants in their natural habitat in the jungle have at the end of one year thrown up single slender stems not a quarter of an inch through.

The return at the end of the second year is estimated at a kilogramme a plant ; *i.e.*, 2,204 lbs., yet a liane as collected by natives in the jungles of full size and probably 4 inches through and 50 or 60 feet long only gives 1 lb. to 1½ lbs. It would indeed be surprising if the plant itself at the end of the second year weighed a kilogramme. From my experience of it I should say the whole thing would not weigh a kilogramme, twigs, leaves and all. Further criticism on this paper is perhaps unnecessary except to point out that the authors give no details as to methods of cultivation, or extraction, of the rubber, and that the price of Willughbeia rubber is always lower than that of the Para rubber, and is generally quoted at about one and six pence a

pound, and it may be doubled that as much as *fr.* 6·25 per kilogramme would be obtained.

Plants of *Willughbeia firma* cultivated in the Botanic Gardens for a number of years, and either raised on trellises or allowed to spread along the ground, in full sun, form thick masses of rather slender twigs. The largest I notice in plants about 13 years old are ¾ inch thick. They are very leafy and dense, but do not develop into the stout lianes so often to be met with in forests. Twigs and leaves, however, are full of rubber, which exudes when the fresh twigs are cut. A few hours, however, after being cut, the twigs, if cut or broken, exude no more, unless they are heated at one end, when the latex begins to exude again with the sap, from the other. It may be possible to use this principle in dealing with *Willughbeia* grown in bush form in the open, or the plants might be cut and crushed with a machine which would press out the rubber, in such a manner that it could be economically collected. It would, however, be also worth while to plant the *Willughbeias* in the patches of forest usually preserved near estates, and allowing them to grow as they like, tap out the lianes when they attain a sufficient thickness to be conveniently tapped. In this way there would be hardly any expense connected with the cultivation except in the original planting and tapping. Any of the other rubber vines mentioned in this paper might be grown in the same way, but besides *W. firma* the best for this purpose would be *W. flavescens* and *W. coriacea*, *Leuconotis Griffithii* and *eugeniæfolius* and the *Urceolas*.

The *Landolphias* of Africa seem to me even more suited for this class of culture than our own rubber vines.

L. Heudelotii and *L.* sp. have made remarkably rapid growth in the open, and their stems under these circumstances attain a greater thickness than do the Willughbeias, but there seem to be some doubt as to the value of the latex of *L. Heudelotii*.

The following dimensions of the branches of various rubber vines cultivated in the Botanic Gardens may show the different values of the plants as regards growth. All are grown in the same class of soil, rather stiff inferior clay, and the measurements are from branches and not of the stumps, which are much thicker :—

Willughbeia firma about 13 years, ¾ inch diameter.
Leuconotis eugeniæfolia 13 ,, 3 inches ,,
Landolphia Heudelotii 4 ,, 2 ,, ,,
L. florida? 3 ,, 2 ,, ,,
Urceola brachysepala 10 ,, ¾ ,, ,,

W. coriacea Wall.—Stems stout, 4 inches through with thick warted black bark, dark red inside, tendrils, long, slender with few curved branches. Leaves very coriaceous elliptic obtuse, nearly lanceolate when young, deep green above, light green beneath (drying red), 3½ to 5 inches long, 2 to 3 inches wide or smaller, nerves obscure, hardly raised 7 to 8 pairs, petiole thick dark brown, ¼ inch long. Flowers crowded in very short axillary tufts, about 6 inches a tuft almost sessile, Calyx very small with short ovate lobes minutely ciliate, Corolla tube short dilated in

the middle pink, ¼ inch long, lobes linear oblong blunt white obscurely ciliate a little longer lobes. Stamens 5 adnate to the corolla tube in its widest part anthers ovate conic, obtuse, filament very short thickened and orange coloured at the back of the anther. Style short green, stigma conic. Fruit large oblong or pear-shaped, 4 inches long, dull green or orange when quite ripe.

Common in Forests, Singapore, Malacca, Penang and Perak. Natives names, Getah Gaharu, Getah Ujol, Jela Puchong Kapor.

One of the commonest species and very variable in size of the leaves, but easily recognized by their very thick stiff texture and few nerves. The rubber is of an inferior quality, however, and seems to be chiefly used for birdlime by the Malays, who also eat the fruit as they do of most species.

W. flavescens, Dyer.—Stem stout, 4 inches through, with rough black bark not warted as in *W. firma*, with broad distant rings elevated and knotty. Bark thick, light fawn colour in section, not red. Leaves dark shining green, elliptic to oblong, or nearly lanceolate, cuspidate with a blunt point, 3—4½ inches long, 1 inch to 1½ inch wide, nerves slender, about 20 pairs of primary ones, petiole thick, rugose half an inch long. Leaves often covered with small conical galls. Flowers in rather lax short panicles, few branched with a peduncle about ¼ inch long, pale yellow, pedicels ⅛ inch in length. Calyx lobes very short, ovate, rounded ciliate. Corolla ¼ inch long, tube swollen, lobes recurved, yellowish.

Fruit globular, about 2 inches long, orange yellow, seeds usually few. Dense Woods, Singapore, Malacca.

"Akar Sa'gran." The latex is somewhat slimy, and of inferior quality. Mr. MURTON, however, sent specimens of its rubber to Kew in 1880, of which Messrs. SILVER reported, "the quality is very fair, and it would be useful in our manufacture. The present value (1879) is about 1*s*. 3*d*. per lb. (Morris Cantor Lecture, p. 43.)"

W. tenuiflora, Dyer.—A stout climber with much of the habit of *W. firma*, with oblong cuspidate dark green leaves with about 25 pairs of straight parallel nerves, prominent on both sides when dry, texture rather coriaceous, not so stiff as *flavescens*. Flowers in short axillary panicles, compact. Calyx lobes rather larger than in most species rounded. Corolla ½ inch long, slender, lobes linear, oblong, longer than the tube, which is dilated at the base. Anthers narrow acuminate. Fruit very large, ovoid, 6 inches long and 4 inches through, light green, with comparatively few seeds. Seeds oblong, red inside.

"Getah Ujol." Woods in Singapore, Malacca, Selangor, Penang.

The latex from this plant is to be mixed with that of Getah grip, i.e. *W. firma*, in the proportion of one-third according to native statements. Mr. DERRY, however, sent a specimen from Malacca labelled "Getah grip" true. It is not a very common plant, but is easily known by the numerous close veins of the leaf, slender long flowers and very large fruits.

W. grandiflora, Dyer? Is a strong climber with rather narrow oblong cuspidate, thin textured leaves with about 30 nerves. Panicles rather lax, half an inch long. Flowers an inch long with broad lobes, the mouth of the tube is hairy, tube swollen at the base. The panicles and large calyx are pubescent.

"Akar Jitan." It occurs in Singapore, Malacca and the Dindings.

This is easily recognized by its very large showy flowers. The leaves resemble those of the last species. In the description of *W. grandiflora* in the Flora of British India the leaves are described as very thickly coriaceous and with only 4 to 7 pairs of nerves, which certainly does not agree with this species. If it is not *W. grandiflora*, Dyer, it must be undescribed.

Chilocarpus.—The species of this genus which is distinguished from *Willughbeia*, by its yellow or orange flowers and fruit splitting when ripe, containing numerous albuminous seeds, though very milky, climbers give, but a poor amount of caoutchouc. The stems are usually at least rather slender, with pale loose bark, their habit being altogether more like that of *Leuconotis* than *Willughbeia*.

Ch. enervis, Hook. fil., which has long been in cultivation in the Gardens, though flowering regularly, has never fruited, and all attempts to propagate it by cuttings or layers have failed. The stems are slender, about ½ inch through, covered with brown wrinkled bark, the leaves are thick and nerveless.

Melodinus—Includes three or four species or climbers with white flowers in axillary clusters, the fruit green or yellow globose, with a hard rind, the seeds numerous, wrinkled, enclosed in a good deal of pulp. *M. Orientalis*, Bl. the commonest, produces an inferior sticky caoutchouc mixed with the other Getah Gerips, but it does not seem to be a very common plant, occurring here only in Penang, though it is met with also in Java and Sumatra. Of our other species, *M. coriacea*, Oliv, a native of Penang, and *M. micrantha*, Hook. fil., a rare plant occurring in Singapore and Malacca, nothing is known as to their rubber-producing qualities.

Leuconotis.—This genus of five or six species is represented here by three kinds, all climbers (not erect shrubs as stated in the Flora of British India), small compared with the *Willughbeias*, but producing useful rubbers. The flowers are in close axillary panicles, orange coloured, the corolla tube is shorter in proportion to the size of the flowers than in *Willughbeia*, and the lobes are thicker and shorter. The fruits are comparatively small with few seeds.

L. Griffithii, Hook. fil.—Stem about 2 inches through. Bark light grey, rather rough. Leaves opposite lanceolate, acute or acuminate, rather thick, nerves about 7 pairs, dark green, 6 inches long and 3 inches wide, petiole 1½ to 2 inches long. Panicles axillary on stout peduncles an inch long, rather crowded. Flowers few. Bracts ovate. Calyx lobes lanceate blunt overlapping nearly as long as the tube. Corolla ½ inch long, tube thick, widest and square at the base, yellow lobes ovate

blunt, recurved orange. Stamens on very short filaments, another lanceolate acuminate acute enclosed in the tube and projecting as far as the mouth. Ovary conic with a stout style and a conic stigma. Disc crenulated. Fruits egg-shaped or pear-shaped, blunt at the apex, 2 inches long, 1½ inch wide in the widest part, yellow, on stout, thickened peduncles, pulp thick, seeds few, oblong rugose flat, olive green.

Usually to be found on borders of woods or open country climbing not high, about 20 or 30 feet as a rule, on trees or bushes, Singapore, Malacca.

This is known as Akar Getah Sundi, but is not to be confounded with Getah Sundik (*Payena Leerii*). The rubber is considered by Malays to be of good quality, and indeed approaches that of *Willughbeia firma*. The latex sets very speedily when drawn out, and leaves but a little liquid.

P. eugeniæfolius, Dec.—Stems dusky grey, about 3 inches through bark ⅛ inch thick rough, with narrow rings 3 inches apart. Leaves rather thinner than the last oblong lanceolate base rounded, apex acute, nearly 6 inches long and 2 wide, nerves 8 to 10 pairs uniting with a distinct intramarginal one, petiole ½ inch long or more, shoots midrib and petioles are covered with a thin rusty pubescence. Panicles axillary few flowered on a stout peduncle 1½ to 2 inches long. Bracts, linear lanceate, green, ½ inch long. Pedicels ½ inch. Calyx lobes cleft to the base, linear green, ¼ inch long. Corolla orange yellow, tube a little longer than the sepals, thick, cylindric, tapering upwards a little, lobes short, oblong, ovate, 5 anthers lanceate, acuminate on very short filaments. Ovary conic, style thick shorter than the filaments. Stigma conic, disc nearly entire. Fruit egg-shaped about 2 inches long, yellow.

Occurs in Malacca, Perak and Penang.

Native name—Getah Gaharu and said to produce the Getah known as Manungan bujok in Borneo (Burbidge).

Urceola elastica, Roxb.—Stems stout 3 or 4 inches through. Branches velvety. Leaves rather coriaceous, elliptic, with a broad base, apices acuminate, 6 inches long by 3 wide, glabrous and shining above, velvety beneath, nerves about 11 pairs, impressed above, prominent beneath. Petiole ½ inch, velvety. Panicles axillary and terminal with long peduncles hairy flowers, small green hairy tufted on the apices of the peduncles. Sepals five linear hairy. Corolla tube as long, urn-shaped, with five subacute erect lobes, all hairy. Stamens 5, meeting in a cone, filaments short, adnate to the base of the corolla. Anthers twice as long, arrow-shaped. Ovary short hairy, style cylindric, stigma cone-shaped. Pods in pairs, widely spreading, cylindric acuminate woody, 6 inches long over ¼ inch through, splitting along the upper margin. Seeds numerous, elliptic, acute, flat, ⅜ inch long, brown, silky, with a whorl of red tufts of hairs at the upper end, plumes an inch long, not stalked, white and silky.

Native names—Gegrip-gegrip tembaga, Getah susu, Gegrip merah (partly) Malacca rubber.

Occurs in thick woods in Penang, Malacca and Selangor, Perak and Sumatra.

This valuable rubber vine was first discovered in Penang by Dr. James Howison, who published an account of experiments he made with the rubber of it in Asiatic Researches (Vol. V, p. 157) in 1798, under the name of the Elastic Gum vine of Prince of Wales' Island, and it was the first of the Malayan Rubber vines discovered. It was described somewhat later in the same publication by W. Roxburgh, who however mistook the fruit of an Orchipeda for that of the Urceola. The species is easily known by its velvety leaves, all the other ones having the leaves quite glabrous on both sides. There seems to have been a good deal of confusion as to the product of this climber. Collins identified the Borneo Rubber known as Gutta Susu as the produce of *Urceola elastica*, but describes the fruit as that of a *Willughbeia*. A rubber vine shown to me in Sandakan as Getah Susu was certainly not an *Urceola*, but a *Willughbeia* or allied plant, possibly *W. Treacheri* (Kew Report, 1880), which is the name which has been given to the Rubber of North-West Borneo. The Rubbers described by Burbidge from Borneo (Journ. As. Soc. Straits Branch, p. 55) are all *Willughbeias* or *Leuconotis*. I have only seen one species of *Urceola* from Borneo, a plant allied to, if not identical, with *U. lucida*, nor has any other Bornean species been recorded so far as I know. It seems likely therefore that all the real Bornean rubber is derived from *Willughbeia* or *Leuconotis*.

It has been questioned whether Howison's Elastic Gum Vine was not *Willughbeia*. He did not obtain leaves or flowers, the description of the stem however, with "strong ash coloured bark, much cracked, which runs along the ground to a great length," does not correspond with that of any *Willughbeia*, all of which have black bark and which do not, as a rule, run far along the ground, before ascending, but agrees altogether with *Urceola elastica*, which is fairly abundant still in Penang.

U. lucida, Benth.—A woody climber. Leaves elliptic with a long point, base rounded, quite glabrous, somewhat coriaceous, nerves about 10 pairs, impressed above, raised beneath, 4½ inches long, 2 inches wide, perfectly glabrous, petiole ½ inch. Panicles axillary and terminal, often large with long slender branches pubescent. Flowers crowded at the end of the branches, very small, green. Calyx cup-shaped with five short lobes, pubescent, very short. Corolla short, lobes rounded, pubescent. Stamens 5 arrow-shaped with long spurs, apices blunt. Pistil conic. Pods in pairs, broad at the base, tapering to a point, woody, 4 inches long or less, about ½ inch through. Seeds few, obovate, pubescent, ¾ inch long, with reddish tufts at the top, plume 1½ inch long.

Singapore, Malacca, Penang, Perak, also Rangoon. A very similar plant with larger flowers was collected in Borneo at Kuching by Dr. Haviland.

Native names—Akar Gegrip Nasi, Getah Grip Merah, Gegrip Besih, Akar Jala.

This can be identified by its short conic pods, very broad in proportion to their length, very unlike any other of our species. The plant, as I have usually seen it, is not a large one, but it probably can attain a greater size. *U. esculenta*, Benth. Tavoy and Pegu, is said by KURZ to be the same species.

The rubber is good, but the plants which I have seen wild, did not produce a very large amount of latex. It is mixed with other rubbers.

U. Malaccensis, Hook. fil.—A fair-sized climber, glabrous except the infloresence. Leaves rather stiffly, coriaceous, elliptic or ovate, lanceolate, acuminate, 6 to 7 pairs of nerves, prominent on both sides, 4 inches long, 1½ inch broad, petiole ½ inch long. Panicles terminal small compact, peduncles short pubescent. Flowers as large as in *U. elastica*. Calyx lobes oblong, lanceolate obtuse, pubescent, nearly as long as the corolla, which resembles that of *U. lucida*. Bracts persistent rather long, oblong, obtuse, pubescent. Capsules twin very long, cylindric, acuminate 6—7 inches long, ⅛ inch through.

Native names—Akar Sankang Buaya, Serapat jantan.

Singapore, Johore, Malacca.

The rubber is considered good and mixed with other rubbers.

U. Maingayi, Hook. fil.—Somewhat resembling *U. elastica*, but quite glabrous with stiff coriaceous leaves and long cylindrical slender acute capsules, occurs in Singapore and Malacca, but is not common. I have no information as to its rubber.

U. brachysepala, Hook, fil.—A fairly stout creeper. Leaves rather thin textured, elliptic acuminate, 3—4 inches long, 2 inches wide, glabrous, rather dull green, petioles ½ inch long. Panicles terminal usually rather large with stout peduncles pubescent. Flowers numerous green. Calyx pubescent, lobes 5, lanceolate. Corolla white, pubescent lobes, ovate, acute, pubescent. Stamens as in *U. lucida*.

Akar Gegrip Merah. A native of Singapore and Malacca.

The rubber is considered good by the Malays, who mix it with other grips. The latex is not very abundant and is rather slimy in cultivated plants.

U. torulosa, Hook. fil.—Leaves small, ovate. cuspidate, coriaceous, glabrous, 3 inches long and 1 wide, petiole ½ inch, nerves 5 or 6 pairs. Panicles small, terminal and axillary, about an inch across, short pubescent, bracts linear, oblong, obtuse. Flowers small pubescent. Calyx lobes linear pubescent. Capsules over a foot long, slender, dilated at intervals where the seeds are. Seed about 8, oblong with a red tuft at the tip and a plume 1 inch long.

Native names—Akar Serapat, Akar Sulo Hutan.

Forests in Singapore, Malacca.

Parameria polyneura, Hook. fil.—A stout climber 4 to 6 inches through, grooved and angled, with light coloured flaky bark. Leaves thin, lanceolate, acute, 3 to 4½ inches long, dark green,

petiole ¼ inch. Panicles lax, terminal, with a few wide spreading branches. Flowers small on pedicels ¼ inch long pubescent. Calyx 5, lobed lobes ovate, hairy, pink, ⅛ inch long. Corolla tube short and broad, nearly ¼ inch long, hairy within lobes, oblong a little longer and blunt, pink with white tips; a ridge runs round the corolla mouth. Stamens 5 short, filaments very short from base of corolla, anthers arrowshaped connivent. Pistil conic. Capsules twin long slender, cylindric, not distinctly torulose red, 15 inches long, ⅛ inch through. Seeds numerous, oblong, linear, blunt at both ends, terminated by a large sessile plume.

This is a beautiful plant when in flower, the flowers though small being produced in great abundance and of a beautiful rose pink. It is known as Akar Getah Grip Putih, Serapit and Sedang, and occurs in Singapore, Malacca and Perak.

The rubber is considered good.

TREES.

Dyera costulata, Hook. fil.—A very large tree attaining a height of 200 feet, with grey rough bark. Branches brown. Leaves in whorls of six, thinly coriaceous, oblong to oblong lanceolate, blunt at both ends, nerves about 15 pairs, 9 inches long by 6 wide, dark green above, paler beneath, petiole 1 inch. Panicles on peduncles 4 inches long, or less with few branches, axillary. Flowers small, ¼ inch long. Calyx short with blunt lobes. Corolla tube as short or shorter, lobes lanceolate, white. Stamens very short, filament very small, anthers conic brown. Style short conic. Fruit a pair of capsules deflexed, woody over a foot long, fusiform blunt, splitting along the upper edge where there is a thin broad margin. Seeds numerous, very thin flat, oblong with a broad wing on each side, 2 inches long and 1 wide.

"Jelutong"—Common over the whole Peninsula. This tree flowers after it has shed its leaves and when the young leaves are coming out. The leaves vary a good deal and are often smaller than described, and in young shoots, stumps, etc., very much larger. This variation in specimens is perhaps the cause of two species of Dyera being described in the Flora of British India, *viz.*, *D. costulata* and *D. laxiflora*. I have not recognized more than one species here, but the Malays do talk of two plants, Jelutong and Jelutong Pipit. This is the plant which produces the Jelutong rubber, in the Peninsula, and if *Alstonia costulata*, Miq., is the same plant (it is only very imperfectly described), it is also a native of Sumatra. MIQUEL gives the name Getah Labuai for it.

I have received another plant from British North Borneo at Labuk Bay under the name of Getah Jelutong from Mr. WADE. This, a branch with leaves only, has the leaves scattered not in whorls, they are rather thin textured, very long and narrow lanceolate, acuminate, 8 inches long, 2 inches wide, with a slender petiole an inch long. It is probably not a *Dyera* at all, but further material is required.

In Dr. HAVILAND's collection from Sarawak is a very distinct plant labelled "Jelutong." It has stout branches with the leaves crowded at the ends oblanceolate obtuse, tapering at the base, thickly coriaceous with about 25 pairs of nerves, straight and prominent, glaucous on the back with a stout petiole 1½ inch long, blade 6 inches long, 2½ wide. The panicle is small with a few branches on a peduncle 4 .inches or less long. The flowers are small, and white, pedicels short and thick. Calyx lobes ovate. The corollas are all fallen in my specimen, but the style resembles that of *D. costulata*.

This is perhaps the plant mentioned under *Dyera costulata* in the Flora of British India as collected by BECCARI and others in Sarawak. It was collected at Kuching, December 25th, 1892 (No. 2170 HAVILAND), and is probably the source of some at least of the Jelutong rubber exported from Borneo to Singapore.

The Jelutong tree abounds in all parts in a very liquid white latex containing a good deal of caoutchouc. The latex pressed between the finger and thumb draws out into fine and fairly firm threads as do the better class rubbers. Allowed to dry in the ordinary manner it becomes hard and brittle, but for sale it is usually coagulated with the aid of kerosine, forming a mealy rubber of a white colour, and of but little value. I am informed that it is chiefly used for making mouldings of picture frames, and for adulterating other local rubbers.

As the tree is very abundant in the Peninsula and attains a very large size, it may be very well worth experimenting with, and owing to the liquidity of its latex will perhaps be a subject for the centrifugal machine. Till recently the tree has almost entirely been neglected both from the point of view of a rubber producer, and as a timber tree. Its wood is soft and white, and was formerly chiefly used for models and native clogs, lately, however, its use for planks for building and boxes has increased, and though it is not very durable it can be used for walls and partitions of houses.

A tree in the Botanic Gardens, about 80 feet tall and 2 feet through, was tapped for experiment. The bark was noticed to be very thick, fully half an inch. The latex flowed freely for a short time and then stopped. Two incisions of 6 inches long and ½ inch wide, one of 12 inches and two of 2 inches were made, on two successive days, and 1¾ oz. of tolerably dry rubber was obtained. The rubber was white and remained so, hardly elastic but easily moulded, insoluble, quite unacted on by ammonia and acetic acid, readily softened and made more elastic in boiling water. In this state a small piece drawn out to over 5 inches when released contracted slowly to about 1½. On drying it became very brittle.

Alstonia scholaris, R. Br.—"Pulai" produces an abundance of latex like that of Jelutong, which dries into a rather hard stiff sheet. It can hardly be used as rubber, and is very rarely collected even for adulteration. The tree is very abundant all over the Peninsula.

Ficus elastica, L. India rubber, Burmah, Rangoon rubber, Getah Rambong, Getah Karet (Java), Getah Achin (Sumatra).

This well known tree is abundant in Burmah, Assam and occurs in Java, Sumatra and also in Perak, on the limestone rocks near Ipoh. It has been cultivated in Assam and Sumatra for a considerable period, and is now in cultivation in the Malay Peninsula. It is raised from seed in Assam and elsewhere, but more usually propagated by cuttings. Mr. G. MANN, whose account (Kew Bulletin, April 1891, also Handbook of Commercial Products, Imperial Institute Series, No. 25, 1893), deals with the cultivation in Assam, states that young trees raised from cuttings are never so hardy as those raised from seed, and do not make equally good growth afterwards. I do not know of any attempt to raise the plant from seed in the Peninsula, cuttings being exclusively used here. Briefly the method of raising from seed is as follows :—.

The figs which are as big as peas are ripe in Assam between January and March. They are collected as they fall and dried in the sun, then broken up and sown in beds, boxes or pots on the surface of the soil. They require as much light from above as possible, side shade is an advantage. The drainage of the soil must be perfect, and it must be kept damp, not wet. Germination takes as much as three months. The seedlings very small at first require very careful treatment. Drip must be avoided, and the soil kept loose.

Colonel WALKER recommends as soil for the seed-beds the following :—Well dug soil one part, sand two, ashes one, old sifted stable manure one, all to be sifted through a wire gauze sieve. When the seedlings are 2 to 3 inches tall, they are transplanted to a nursery bed in lines 1 foot apart, and when 1 to 2 feet tall, they are very hardy and can be planted out. For cuttings perfectly ripe young branches should be used. They require a band of cocanut fibre or matting to be tied tight round the branches, which is left on till the roots are seen projecting through the mat. This takes about three weeks, the branches are then cut off below the roots. They usually grow with remarkable ease, but it sometimes happens in damp ground that a fungus attacks them, and they refuse to grow. In this case the infected ground should be abandoned, as it is useless to attempt to grow cuttings there.

When the cuttings are well rooted they can be at once transferred to the plantation, and as the trees become in time very bulky, they should be planted 40 to 60 feet apart. The tree grows rapidly and can be tapped in six or seven years after planting. The part tapped is the aërial roots. A large tree with well-developed crown and three or four stems is said to produce 210 to 245 lbs. rubber the first year of tapping, 140 lbs. the next, 52 to 70 lbs. the third, the fourth year nothing, but after two years' rest 80 lbs. may be obtained. Heavy tapping like this is, however, injurious to the tree, which becomes weak and dies. In Sumatra, a planter told me that India rubber gives about the same return as Hevea, for the same number of years.

The amount of rubber produced is, however, apparently apt to vary according to locality, for it is stated that in Assam the form which grows in the plains produces but little rubber, though much latex is produced, while that on the hills produces much rubber and little water.

How the plant will work out in different parts of the Peninsula we cannot judge at present. It undoubtedly grows very well in the low lands round Klang, in Selangor, in Perak and the Dindings and elsewhere. It grows very poorly in the stiff clays of Singapore, and here seems to be very liable to the attacks of fungi, especially of a leaf fungus which causes a fall of the leaves. It may be doubted that it will give the same return as Para rubber, but I saw an excellent sample obtained from some three-year old trees grown by a Chinaman in Malacca. The product is usually considered inferior, and the amount, as has been said, is remarkably variable. Next to Para rubber, however, Rambong is probably the best rubber to cultivate in the Straits. It is already being cultivated successfully in Sumatra, the produce being shipped to Penang in fairly large quantities. In 1897, 4,650 piculs were shipped from Penang, but this includes some wild Rambong from Perak, and probably also Sumatra.

INSECT PESTS.

There are few more annoying losses to a planter than those caused by some of the very numerous forms of insect life in the tropics, especially in cases where, as often happens, an, insect which though known to be feeding on the plant under cultivation, inflicts for many years such trivial damage that it is quite neglected, till suddenly it appears in numbers so vast that before it can be checked, much damage has been done and no small expense has to be incurred before the estate can be saved. For this reason it is necessary to watch for insects on the crops very carefully, and to keep under observation any which inflict injury, however slight, lest they become from neglect really dangerous. In this region we are fortunately free from those insects, such as locusts, which invade a district in great flights, and in a few hours undo the labour of years, but we are not free from attacks made in force arising from neglected and dirty estates. Many troublesome invasions arise from abandoned patches of scrub and weeds allowed to grow near or in the estates, round the coolie lines and elsewhere. Grasshoppers and moth-caterpillars often haunt these patches for some years unnoticed and gradually commence to attack the estate itself. Sometimes again a pest destroys the stems or boughs of the trees, and the coolies cutting or breaking off the dead boughs still full of insects throw them on the ground, or leave the dead stumps on or near the estate, instead of burning them. The result naturally is that the insects continue to breed in the decaying wood, and a constant supply of the pest is kept on the estate. Much of the serious injury done by the coco-nut and nutmeg beetles in native estates is due to this neglect. If a tree is killed by any insect or by any fungus, it should be removed and destroyed without delay for fear of spreading the infection.

It not unfrequently has happened that an insect which normally feeds on some waste stuff such as dead wood, or decayed vegetable refuse, alters gradually its mode of life and commences to attack living plants, often inflicting considerable injury. Notable cases are those of the sugar shot-borer, *Xyleborus perforans*, well known for its habit of boring into wine casks and causing leakage, which, in the West Indies having probably been imported in a wine cask, attacked the growing canes and hopelessly destroyed some estates. The black coco-nut beetle again normally lives on cowdung and rotten wood, but now attacks and destroys palms, and *Xylotrupes gideon* the grub of which normally feeds on cowdung and decomposed vegetable matter, having found its way into the cane-fields commenced by feeding on the decaying portions of the sugarcane cuttings and has ended by attacking the living roots and destroying the plants. Some

insects seem to be almost omnivorous, but most attack only a certain plant and those most nearly allied to it, unless the food supply runs short when they fall upon the nearest plant that they can eat, as happened recently in Selangor when caterpillars, which had been feeding on castor oil plants grown near coffee, having devoured all the castor oil plants, fell upon the coffee bushes and commenced to eat them.

A pest sometimes after being easily kept within bounds for years, may, for no clear reason, suddenly on some year, become so abundant that it is quite uncontrollable, perhaps almost entirely disappearing on the following year, and not reappearing for a long period. The cause of this is not very clear, and it is usually attributed to variations in the weather, or the accidental absence of some enemy of the pest. During the time of the great plague of the Coffee-caterpillar in Selangor, 1898 and 1899, I noticed that several other kinds of caterpillars were extraordinarily abundant, notably that of the small yellow butterfly, *Terias*, which feeds on Albizzia. It is quite possible that in this case some abnormality in the weather proved either exceptionally suitable to these insects or exceptionally unsuitable to some particular enemy, but observations on these points are still required. The blights (Coccidæ) and aphides are very apt to be more virulent when the weather is damper than usual.

Plants that are sick or ill-nourished suffer more from insect pests than those in a healthy condition, and it is wonderful to note how manuring a tree will often cause the disappearance of blights which have resisted tuba water, tobacco or other insecticides. This shows that the miserable appearance of the tree was not due to the attacks of the blight, but that the blight persisted on the plant on account of its sickness. The same thing often happens even in caterpillar attacks, the trees which are sick have no recovering power and fail to throw out fresh leaves after the destruction of the old ones in time to save its life.

In some regions, trees which would otherwise thrive are practically kept out of cultivation by insect pests. The Mango in the south of the Peninsula is an example of this. It is attacked by so many insects that it really has no chance. The worst of these is a boring caterpillar which burrows up the branches, which soon die and fall off. It is interesting to note that the only trees not badly attacked here are those growing over water. It has long been known in Europe that ponds underneath trees often keep off insects, especially beetles and moths, which are perhaps afraid to cross, the water or if they do, fall in and are drowned.

Groups of Insects.

A short summary of the groups of insects may be of use in enabling a cultivator to judge whether an insect found on or near his plants belongs to an injurious group or not, as in many cases the enemy of the pest is mistaken for the enemy of the plant.

Lepidoptera.—Butterflies and moths are only injurious here in the caterpillar state. The caterpillars are soft bodied, often

hairy, and feed on leaves often by night, only concealing themselves by day, or bore into branches of trees, or not rarely attack fruit. The group of *Psychidæ* or "Bag worms" is known by the caterpillars inhabiting tubes or cases made of silk usually coated with bits of stick, bark, or leaves. They feed on leaves and are often very destructive. The *Limacodidæ* have woodlouse-shaped caterpillars (*Parasa lepida* is an example), often brightly coloured and armed with stinging hairs. They pupate in curious round leathery cocoons on the leaves. One of the worst groups as pests is that of the *Noctuidæ*, with hairless or nearly smooth fleshy caterpillars, leaf-feeders, often occurring in vast abundance, and feeding sometimes by night. The moths are thick bodied and often dull brown or grey. The *Sphingidæ*, or Hawk-moths with large perfectly smooth caterpillars always furnished with a horn on the tail, rarely occur in sufficient numbers to do damage, but the Coffee beehawk, as described below, shows that we cannot trust to any group of moths as being always harmless. Very destructive also are the *Tortrices*, or leaf-rollers, which roll or spin the leaves together, remaining in the rolled up portion. The Gutta Percha moth and Ramie moth belong to this group. It is a very difficult group to deal with, as the caterpillars here will not leave their retreats when the tree is shaken, as they do in England, and spraying with poisons has no effect on them, as the leaf protects them. Handpicking is the only chance with these animals. The *Tineæ*, which are usually very small moths, chiefly devote their attentions to stored produce. One very minute one attacks herbarium specimens and dried leaves of any kind. A grey moth about half an inch long (probably *Tinea granella*) I found destroying rice. The caterpillar, a dirty white grub spun the grains together, and devoured them, utterly destroying the rice; another attacks dried figs and other fruits, and the clothes moth, *Tinea tapetzella*, is well known to all.

Butterflies are less injurious to the planter on the whole. The worst we have here are the Banana butterfly, described below, the cocoanut butterfly *Amathusia phidippus*, *Papilio Erithonius*, which devours the leaves of the orange, and a few like *Cyaniris lavendulacea*, which eat the young leaves of Cycads, and other ornamental plants.

The *Hymenoptera*, Bees, Wasps, Sawflies and Ants, are four winged in the adults, the grubs being soft white, footless maggots usually requiring to be fed by the adults, except in the case of the Sawflies, the caterpillars of which closely resemble those of moths. They are a comparatively harmless group. The Sawfly grubs eat leaves, but are not often abundant. The only injurious one I have seen here feeds on rose leaves, and is described below. The carpenter-bees *Xylocopa*, make themselves a nuisance by tunnelling the beams and poles of buildings. The Gallflies, *Cynipidæ* may be injurious to foliage and twigs.

On the other hand, the bees and wasps do good service in fertilizing the flowers of many of our crops, while the Ichneumons destroy many caterpillars by laying their eggs in them, and the

Burrowing Sandwasps carry off caterpillars, crickets and other insects besides spiders to their nests to feed their young. The ants are on the whole useful to the planter, but do a certain amount of harm.

The *Diptera*, Flies, with one pair of wings only, are, as far as agriculture is concerned, almost harmless. A certain number produce galls on plants. One species is destructive to the Chocho fruit, the grub feeding on it, and on one occasion I found bed after bed of English peas and beans totally destroyed by the maggot of a fly which I was not able to rear. The flies, however, are important flower fertilizers, especially to trees with small green or white flowers, such as Rambutan, Pulassan, the Chesnuts, also the Durian, Urceola, and Nutmeg.

Coleoptera.—The Beetles are known easily by their having four wings, of which the upper pair are hard and opaque, often coloured and when at rest cover the lower transparent flying pair. They comprise the largest number of bad enemies of any group. The most destructive sections are the Weevils (*Curculionidæ*), the Chafers (*Lamellicornia*) and the very small borers (*Scolytidæ*). The Weevils are injurious only in the larval stage. The perfect insect is generally a very hard-coated animal and is always known by its long hard curved beak. The grub is thick, footless, white soft with a hard head and powerful jaws. It always lives in burrows in living plants or seeds. All are injurious, among the worst here are the Red palm weevil, *Rhynchophorus ferrugineus*, the Banana weevil, *Sphenophorus sordidus*, the small Rice weevil, *Sitophilus oryzæ*, and *Astychus*.

The Chafers (*Lamellicornia*) have broad thick bodies with blunt heads and are often armed with horns. The antennæ end in a dilated club consisting of a number of flat leaves. The grubs usually live in the ground or on rotten wood, or other vegetable refuse. They are white and fleshy with large brown heads and powerful jaws, the body curved and swollen at the end, so that they have always to lie on their sides. They have six small legs near the head. Sometimes it is the grub only which is injurious, by biting the roots of plants. Sometimes the beetle itself devours leaves or bores into the plant to suck the juice of it. The Black coco-nut beetle (*Oryctes rhinoceros*) is one of this group, as is *Xylotrupes Gideon*, of which the grub destroys the roots of the sugarcane, and the beetle bites into the cane itself. Some of the small chafers fly by night in enormous numbers and eat the leaves of cultivated trees voraciously, reducing them to rags.

The shot-borers *Scolytidæ*, are all very small, even minute-beetles cylindrical brown or black. They bore into dead or dying wood or live in living bark. The grubs are very minute, white fleshy insects. When numerous the attacked part of the tree looks as if a charge of small shot had been fired into it. The worst of them are the species of *Xyleborus*, and *Phlæosinus*, which destroy nutmeg trees and sugar canes. Some also destroy bamboos when cut, reducing them to powder, and attack also books, furniture, etc. Most of them normally feed on dead wood, but

they have a habit of leaving that to attack living wood, and estates in which rotten wood is allowed to lie about unnecessarily are very liable to attacks from this group of insects.

The *Longicorn* beetles with oblong or cylindrical bodies and long slender recurved antennæ, are all wood-borers. They are often of very large size, and are sometimes very troublesome. The grubs are long, cylindrical flattened insects without legs and live in burrows in timber, which are usually filled with the powder of remains of the wood they have eaten. I have not as yet met with any injurious to living trees here, but they are often very destructive to house timber.

The Leaf-beetles (*Chrysomelidæ*) rounded thick and curved, or oval and flat, often gaily coloured, and usually quite small, are generally found on leaves which they eat. I have seen but few on plants cultivated for use, but several are troublesome on our ornamental plants, orchids, aroids, etc.

The useful beetles belong to the carnivorous groups. *Carabidæ*, of which the tiger beetles which abound on sandy paths, flying briskly about for short distances at a time, are the commonest. They feed on other insects.

The other carnivorous group of importance is hat of the Lady-bird, *Coccinelidæ*, of which we have several species, which eat the plant lice and green flies (*aphides*) commonly known as blight. The beetles are red or yellow with black spots, the larvæ are oval or long soft-bodied insects which creep about on the leaves and devour the blight. One species is often to be seen on Coffee, when there is blight about. Of course these insects must be carefully protected.

The true bugs, *Hemiptera*, are known by the long-pointed beak generally carried when at rest in a groove or merely along the under surface of the thorax. Besides the true bugs large often gaily coloured animals with a very foul odour, the group includes the plant lice Coccidæ Aphides and Scale insects. The greater number are very injurious, sucking the juice of plants with their long beak, such are the rice-sapper, *Leptocorisa* and *Dysdercus*, but a few are carnivorous attacking caterpillars and other insects ; one of these is described below as destroying the beehawk caterpillars on the Coffee. The Cicadas, well known to all here from their noisy songs and commonly called here by the ridiculous name of tree-beetles, confining themselves to the forests, seldom injure the planter. A curious woody swelling very common on the boughs of Serayah trees (*Shorea leprosula*) is caused by the presence of the eggs of some species of Cicada, which appear to be deposited in the bark. This is very injurious to young trees. The larvæ however live in the ground after hatching and feed on tree roots.

The *Orthoptera* include a number of injurious insects in the form of grasshoppers, locusts, crickets, and mole-crickets. The first three groups devour leaves, and often cut down seedlings in the nursery beds, and as many work at night, only hiding in holes in the ground or under logs and rubbish during the day,

are very difficult to deal with. · The mole-crickets live in burrows, where they devour the roots of various plants and are fearfully destructive when they get into nursery beds. They are recognized by their brown velvety bodies and mole-like digging paws. They can be caught at night sitting in the mouths of the burrows and making a piercing whistling.

Another destructive group is that of the walking sticks and leaf insects both leaf-eaters. Two or more stick insects are very destructive to orchids, Calatheas and Sansevieras. Resembling little pieces of wood or straws and usually concealig themselves during the day time among the roots of these plants, they devour the leaves and shoots at night. A very fine leaf-insect, exactly resembling the leaf of a mangosteen, was brought in lately from mangosteen trees which it fed on.

The well-known Mantis is carnivorous, feeding on other insects, and is therefore useful.

Like other groups, the *Neuroptera* can be divided into insectivorous and vegetivorous kinds. The dragon-flies are predaceous and live on small insects, and turn up often in great force, when the Termites (white ants) are swarming, clearing off many of these insects. The Termites belong to the same order, and are the only injurious insects of this order here.

The two remaining groups, Thysanura and Collembola, affect the planter but little. The Sugar fish, *Lepisma*, too common in houses, belonging to the first order, is a very troublesome little beast on account of the way it eats papers into holes. Napthaline will keep it away. The minute Collembola like very small lice, would hardly be worth mentioning as affecting planters at all, especially as there are comparatively few here, but considerable suspicion must attach to one species, a very minute white insect usually found under stones, *Lipura fimetaria*. Many years ago I found it in immense abundance on a fern in England, which was in a very sick state, and lately MR. STANDEN brought me from India, among other insects, a quantity of the same thing which had been found at the roots of seedling Cinchonas, which were evidently dying from root injury probably caused by these little animals.

The order *Myriapoda*, Centipedes and Millipedes, is allied to the insects and may be mentioned, as there are several of the millipedes which seem to be very destructive, notably a cylindrical red one often found in manure, sometimes in quantities. It attacks the roots of seedlings especially. The centipedes which are distinguished at sight from millipedes in having flat backs instead of rounded, and running very fast when disturbed (whereas a millipede moves slowly and sometimes curls up when touched feed on insects, and I have found a very large centipede killing the larva of a coco-nut beetle.

Destruction of insects.—In the case of an attack on a plantation by an insect pest, the first thing to do is to find out the life-history of the animal in order to know at what poin in its life it is most easily dealt with. Some insects are most easily and eco-

nomically destroyed when in the larval state, others when adult. In many cases handpicking is the most economical method in the end, especially in the case of leaf-feeding caterpillars when present in abundance, but poisonous substances can at times be used successfully. These are especially valuable in the case of Blights (*Coccidæ*), green fly, etc. The best are tuba-root, tobacco, phenyl, kerosine and soft soap and sulphide of potash. London purple and Paris green are extensively used as insecticides in some parts of the world, but I have not found the former at least very successful here. It is purple powder insoluble in water, but it is generally used mixed with water for convenience. On the grubs of the coco-nut beetle I found it had practically no effect either dry or in water, the grubs burrowing about in the powder quite unharmed, nor was it more successful in the case of the bee-hawk caterpillars, though the younger ones were killed by being wetted with a mixture of London purple and water, the larger ones soon recovered. It is however useful against termites either sprinkled in holes for posts, or painted on the wood work in the form of a mixture with kerosine. In this way it can be used against the house termite (*Calotermes domestica*). It must be remembered that, as London purple and Paris green, are preparations of arsenic, they must not be used on fruits or vegetables intended for food. Sulphide of potash in solution seems to be more deadly to caterpillars and is not at all injurious to plants, but rather acts as a manure. Tuba root (*Derris elliptica*) is pounded and soaked in water, making a soapy mixture, which is deadly to many insects, especially caterpillars and blights. Phenyl is useful for blights and especially those white Coccidæ which are protected by a coating of wax which throws off the insecticide liquid, but which is partly dissolved by Phenyl, which is then fatal to the insect. Phenyl is a tarry looking liquid which, when mixed with water, resembles milk. It should be stirred with water till it is of the colour of good milk, used thus it has no bad effect on even delicate leaves. For tobacco water, the ordinary Javanese tobacco can be used soaked in water. It can be improved by the addition of soft soap which causes it to adhere better to the leaves. Kerosine and soap is also a good mixture for blights.

These liquid insecticides can be sprinkled from watering cans or syringes, or a spraying machine of which many kinds have been invented, can be used. For a large area the latter is the most suitable. The great amount of rainfall militates against liquid insecticides as a heavy shower is apt to wash it away before it has taken full effect.

The best work on insecticides is Lodemans "Spraying of plants" (Rural Science Series).

Smoking the trees with sulphur or burning rubbish requires a good deal of care or the trees may be damaged. Small pots of sulphur on poles held near bushes will often clear off caterpillars and has been used successfully, it is said in Java, but fumes of sulphur, if prolonged, are apt to damage the foliage.

Traps consisting of a lamp over a tray of molasses or other sticky sweet substance catch a considerable number of crickets and beetles. The ordinary moth trap is useful for moths, and often catches beetles and crickets. The coco-nut butterfly enters it readily and may be taken in numbers. It is a cylindrical structure made of mosquito curtain stretched on two rings of rattan, about three feet tall, the top is conical and is best made of some opaque cloth. In the sides are small doors made, by which the insects enter. A bait of over-ripe plantains is hung in the middle of the trap or a lamp is fixed in the centre. The trap is hung up by the top in paths or open spaces, and the insects fly in by the doors and are unable to escape. I have known as many as thirty coco-nut butterflies taken in one of these traps in one evening.

Further information on injurious insects of the Peninsula is still wanted, and any persons who find insects injuring their plants would do well to send them for examination with such notes as they can make as to their habits, to the Director of the Botanic Gardens.

Lepidoptera.

Amathusia phidippus.—The Coco-nut butterfly is a large insect, the wings of which are brown above, and paler beneath, with light wavy bands running across both wings and two large eye-shaped spots on the lower wing. It is very common in coco-nut estates, hiding among the leaves by day and flying, only at sundown and just before sunrise. The caterpillar is 3 inches long, hairy, with a bifid tail. It eats the leaves of the coco-nut palms, reducing the leaflets to the mid rib, and when abundant, they give the trees a most miserable appearance. I have never heard of their destroying a tree completely however, but should they become really injurious, they might be caught in moth traps baited with bananas, into which they readily go

Papilio Erithonius.—The caterpillar of this is very destructive to orange, lime, and pumelo trees, chiefly however to young plants. It is a very striking insect of a dull bluish green with black markings, somewhat resembling a bird dropping, but especially remarkable for its protruding, when touched, two long red fleshy tentacles from its head. The chrysalis is attached to the plant by a thread as in most butterflies and is green. The butterfly is black with cream coloured spots, a bluish and black eye on the upper part of the hind wings and a red spot on the inner side at the lower part. Few orange seedlings escape being attacked by this caterpillar, and it is requisite in raising young plants to keep a look out for this insect which very soon defoliates a young plant and kills it.

Erionota thrax.—The banana skipper, a brown butterfly with 3-squared yellow spots on each wing and dull red eyes, body and wings dull brown. It is 4 inches across the wings. This very common insect is in the caterpillar state very injurious to bananas, and also attacks palms of various kinds. The eggs are

laid on the leaves or oftener on the stem of the banana. They are bun-shaped, white with pink stripes, radiating from the top downwards. The caterpillars when hatched are pale green with rather a large black head. When full grown they are about 3 inches long, sea-green with a large round black head, sprinkled over with hairs and covered with a white floury substance. They live in rolled up portions of the banana leaf, and by tearing and rolling up the leaf, destroy far more than they actually eat. The rolled up portion in which the grub lives is covered inside with the white floury substance which appears to act as a protection against rain water, which is apt to accumulate in the rolled up tube of the leaf. The substance being of a waxy nature prevents the water touching the animal's skin. It also acts to a certain extent as a protection against animal enemies, such as ants, which I have observed on attempting to bite the caterpillar and getting a mouthful of the waxy substance soon abandoned the attack. The caterpillar pupates in the rolled up leaf. The chrysalis is rather long for the size of the butterfly, and is also covered with the waxy secretion. This animal is so abundant that in most places it is difficult to find a banana which has not been attacked by it. It lives on all kinds of bananas including Manilla hemp (*Musa textilis*) and the wild Musas, also on coco-nuts and other palms. I have seen banana plants quite torn to pieces by this caterpillar, the leaves reduced to the mid rib and a row of rolls on each side, but as a rule unless very abundant the damage they do to the plant is trifling. It is however advisable to destroy them, which is easily done by handpicking. The butterfly usually flies in the evening and sometimes even comes into light.

In some places a very similar but larger skipper, *Gangara thyrsis*, attacks bananas in the same way, but as a rule it is a less common insect.

The Coffee-hawk Moth (*Cephonodes Hylas*).

The enormous amount of damage caused to the coffee in the past two years by the bee-hawk moth (*Cephonodes Hylas*), especially in Selangor, in the neighbourhood of Petaling, has caused so much alarm, that some account of the pest, its life-history and the means used to destroy it must be of interest to many persons residing in the East. In compiling this account of it, I have availed myself of the notes made by Mr. A. L. Butler of Selangor Museum, whose observations I publish *in extinso* and by Mr. J. Goodenough, Forest Inspector, and what information I could glean from planters in the district, during my visit to the infected estates in February, 1899. I also saw an outbreak of the same plague some years ago on the Chasseriau Coffee Estate in Singapore, where however, the damage was not so severe.

Description of the Moth.—The moth belongs to the group of the *Sphingidæ* (a group, as Mr. Butler points out, any members of which have very seldom been reported as causing any appreciable damage to crops of any kind), and it is closely allied to the English Bee-hawks characterized by their transparent wings. It

is of comparatively small size, being only 1½ inches in length from head to tail and nearly 3 inches across the wings. The head is rather broad, olive green in colour, the antennæ half an inch long narrowed at the base and dilated upwards, ending in a short slender point. The thorax and first three segments of the abdomen are covered with olive green fur, the fourth segment of the abdomen is nearly black with a thinner coating of green fur, the fifth chestnut red, the sixth yellow edged with black with a central red spot, the tail yellow, ending in a broad black brush like a fish tail in shape. Beneath the thorax and first abdominal segment are white, the next three segments red and black, the last ones white with a black centre. The legs white beneath and grey above, the terminal joints long black. The wings are quite transparent except for the broad upper margin and veins, which are black. It is diurnal in habit, darting about the Coffee bushes with great rapidity during the sunshine and disappearing during rain and when the sun goes down. While the coffee is in flower it can be seen hovering over the flowers and darting from one to another to suck the nectar, and probably fertilizes the flowers to some extent. It was noticed that when the Coffee flowers were fallen the moths usually disappeared and estates which happened to be without flowers when the moths were about were but little affected by the pest, but in estates not previously attacked as soon as the Coffee flowers were open the moths came in great numbers from other plantations. This group of moths being very powerful on the wing can fly very long distances with great ease, and are therefore often very widely distributed.

The eggs are deposited singly upon the leaves usually on the underside. The moth does not settle, it darts at the leaf and giving a sudden forward jerk of its tail places the egg on the leaf where it sticks. In some places where the coffee leaves had been so far destroyed that there was not a sufficient supply for the moths, they were seen to deposit their eggs on Lalang grass, or other herbage.

The *eggs* are small and globular of a semitransparent green colour with a rather hard shell; they are but loosely attached to the leaf and are easily rubbed off.

The *Caterpillars* when first hatched are green with a yellow head and a long black horn on the tail. As they developed they changed colour, and were very varied. Caterpillars of apparently the same ages being entirely different in colouring. The following variations in colour in the older and full-grown caterpillars were noted:—

A. Body green with a row of black dots on the sides above the spiracles and a white line running through the line of dots; neck covered with small yellow pustules.

B. Light green with a yellow stripe and black dots, horn green with black base.

C. Head green, neck with yellow pustules, body ground colour green with broad black dorsal band with fine black stripes on the side, legs and belly dusky with a white

lateral band and green and white regular triangular blotches over the spiracles; horn black.

D. Light green with a whitish band along the back, a pink side line and a green horn.

E. Head ochre yellow, body grey, spiracles yellow with a white line above them, legs black, hinder ones spotted with yellow, horn ochre at the base, black above.

When full-grown the caterpillar is about 3 inches long. It is very voracious, devouring the leaves, and when they fail attacking the unripe cherry, the bark, flowers and buds. Besides the Coffee bush, it feeds on the *Gardenia*, which appears to be its natural food in Ceylon. I noticed that round the cooly lines at the spot where the outbreak was stated to have commenced there were Gardenia bushes, and during the outbreak caterpillars were found on Gardenias in several places near Kuala Lumpur.

The insect is known to occur in India, Ceylon and Java, but I cannot find that in any of these places it has been found attacking the coffee.

Enemies.—The only enemy of this insect that I noticed was a large black bug, which was seen to attack not only the caterpillars but was able also to seize the moth as it was laying its eggs on the leaves.

The bug is about an inch long. The head very narrow, about ¼ inch in length with a long, rather stout, curved beak. The antennæ very slender over ½ an inch long. The eyes large in proportion to the head. The thorax broad rhomboidal dull black, the abdomen nearly half an inch long, broad, with the sides turned up, so that the wings which are of a dull bronzy metallic yellow, in a depressed space between the raised margins. The legs are long and slender (see plate).

I have usually seen this bug flying about jungle paths, but at Petaling it had come from the forests and was flying about among the coffee bushes. It drives its long beak into the moth or caterpillar and sucks its juices. If handled it bites very sharply in the same way and its bite is very painful, being evidently poisonous. The insect was unfortunately not sufficiently abundant to cope with the immense abundance of the caterpillars but it certainly helped to destroy them.

Mr. Butler in his notes points out that both the Magpie robin and common bulbul attacked the caterpillars and destroyed some.

History of the attack.—The Manager of Petaling Estate stated that he first noticed the pest in the latter half of December, 1898, and put on all hands to destroy the caterpillars. It is probable however that the attack really commenced much earlier in the year. In the beginning of February, six weeks after the caterpillars had been noticed, they had spread over from half to two-thirds of the estate, and in many places could be seen rows of from 30 to 40 trees stripped of leaves, and with the berries gnawed. Mr. Aldworth, in a report to Government, counted at this time 204 caterpillars on an average tree, and estimated

that there were 90,000 to an acre, or about 22½ millions to the whole plantation.

Calculating the sexes to be equal, this would give at the estimated number of eighty eggs to a moth, the enormous amount of nine hundred millions of caterpillars on the estate at the next breeding season, within a period of four months from their first being noticed. The estate coolies being insufficient to keep down the pest, though destroying 300,000 caterpillars a day, the Selangor Government assisted by supplying additional labour and in a few months the plague was so reduced as to be manageable.

Beside handpicking, other means were tried to destroy the insects on a large scale. Butterfly nets were supplied to boys who caught the moths, and though a number were killed like this, the value of this work was reduced by the fact that the moths which were most readily caught were those that had finished laying their eggs, the more active ones fresh from the chrysalis escaping. Experiments were tried with London purple and sulphide of potassium, tuba root and smoking with sulphur, but none of these were of any practical result. London purple, which has been used to kill caterpillars in other parts of the world with so much success, has here proved useless, for what reason I cannot guess.

I have tried it on many kinds of caterpillars and find that it either acts so slowly that the caterpillars can easily free themselves from it, or does not kill them at all. Sulphide of Potash in solution is more rapidly fatal and with a proper syringing apparatus, might be utilized with good results in similar outbreaks, especially as besides being fatal to the insects it is beneficial also to the plant as a manure. Tobacco water, soap, tuba roots, quassia, etc., seemed to be fatal only to the very young caterpillars and not always to those. The moths being entirely day flyers cannot be attracted by light and an attempt to attract them with a powerful kerosine lamp ended in a catastrophe fatal to four persons.

Handpicking and shaking the trees so as to dislodge the caterpillars and eggs seemed the most effectual and economical method, but in cases like the present it should be begun on the appearance of the pest and kept up till all danger is over. The chrysalides should be collected from their hiding places in rotten wood and dead leaves, etc., and where they can usually be found crowded together, as the caterpillars do not go far fro them bushes to pupate.

Notes on the Bee-Hawk Moth Caterpillars.

(*Cephonodes Hylas*). By A. L. Butler.

I visited Petaling Estate on January 31st. There were then millions of the caterpillars busy at their work of devastation, almost all were full-grown or of medium size, and I saw no eggs or very small young ones. Not a single moth was to be observed on the wing. The part of the estate worst attacked was on the

left of the railway line (facing Klang). The amount of damage done was extraordinary, a large acreage being almost completely stripped, as many as 50 for 60 consecutive trees often not having a single leaf left on them. On these trees the caterpillars were busily feeding on the rind of the green berries, to which they invariably turn when the leaf supply is exhausted. Whole branches of berries had suffered thus, looking very much as if the rind had been gnawed off by mice. Where any leaves remained the berries were practicaly untouched, and as long as any *green* berries remained the ripe ones were seldom attacked, though the caterpillars in some cases turned to these finally. At this date (Jany. 31st) thousands of chrysalides could be collected in a very short time, the debris of earth and dead leaves round the bases of the coffee trees, and every piece of rotten wood, etc., lying about being full of them. The caterpillars go through the transformation into chrysalides only just beneath the surface of the soil; sometimes on it, covered only by the deed leaves which collect round the stems of the trees. They are always found in a horizontal position, and by constantly wriggling from side to side in the loose top-soil usually make themselves a cavity a little larger than their bodies.

When approached or aware of danger, the caterpillars cease feeding, raise the fore part of the body with the head bent downwards in the usual Sphinx caterpillar style, and remain motionless while danger threatens. When touched they secrete from the mouth a drop or two of a greenish brown fluid, which on exposure to the air, immediately becomes a rich golden-brown very like iodine, staining the hands or clothes wherever it touches. Of small and medium sized caterpillars, I noticed that this fluid was usually of a bright grass-green for a second or so after secretion; in the larger ones it appeard to be of a greenish brown immediately it left the creature's mouth. Presumably this fluid has an extremely unpleasant taste, and is the caterpillar's only protection against insectivorous birds and animals.

The colouring of the caterpillar changes a great deal during its existence, and is not protected, beyond being green when the skin has been newly shed. In fact a protective coloration would be rendered useless by the very numbers of the larvæ, which, crowded together on the half stripped twigs of an attacked tree, are of course conspicuous.

I have seen the green pods of a kind of vetch at a distance closely resembling these caterpillars in shape and colour, the horn at the end of the pod corresponding to the horn on the caterpillar's tail did such pods occur on the food plant of the caterpillar; the purely accidental resemblance might be taken as an instance of mimicry.

On February 2nd I again visited Petaling Estate and brought away a large muslin cage full of caterpillars and chrysalides. No moths were visible on the wing. On the third, two moths hatched from my chrysalides; on the 4th, three and so on until the 9th, when all I had brought home were hatched. At the

same time an enormous batch of the perfect insects hatched out at Petaling, and for days the whole estate was humming with moths whirling and darting among the coffee trees in countless thousands, poising themselves over the fragrant blossoms or just pausing for an instant over a leaf to curve their bodies downwards and deposit an egg.

I fed my moths in captivity on plantain juice, which they sucked greedily.

At 1 P.M. on the 8th of February, I observed a pair of moths, four days old *in copula;* they were still paired at 5 P.M., but were separated when I looked at them again at 8 P.M. I isolated these two individuals for observation. Two days later, on the 10th the male died. The female after impregnation became very lively, whirling round and round the bottle most of the day. On the 13th this moth died, and on opening her I found 88 eggs apparently quite ready to be deposited. This number was about what I found in several gravid females dissected and is, I think, about the average usually laid.

Between the 5th and the 10th of the month a large number of the captive caterpillars turned into pupæ. These were all very noticeably smaller than the wild chrysalides, the difference in size being doubtless due to the fact that the caged larvæ were fed always on *plucked* and *withering* coffee leaves instead of growing foliage.

The time taken by moth's eggs to hatch, and the duration of the pupa stage are very variable and dependent on climatic conditions (pupæ are frequently 'forced' by English collectors), but as far as my observations go the different periods in the life history of the Bee-Hawk moth are approximately as follows :—

Egg stage : 5 days or a week.

Larvæ stage : 4 to 5 weeks.

Pupa stage : 10 days or a fortnight.

Imago stage: doubtless varies greatly. Females are probably impregnated within 3 or 4 days of hatching, lay their eggs about a week later, and die a few days afterwards. Males probably only live a few days, dying after fecundating a single female.

It is quite impossible to put an exact period to the different stages of an insect in the wild state, but the above data gathered from my specimens in captivity, are probably fairly near the mark as they come altogether to about two months, the interval of time occurred between the big hatches of the moth at Petaling.

The Bee-Hawk Moths seem to have practically no natural enemies, or rather no natural enemies sufficiently numerous to afford any check to their ravaging millions. Personally I have only seen two birds touch them, the Magpie Robin (Copsychus saularis) and the yellow-vented Bulbul (Pycnonotus analis); both of these feed on the small and half-grown caterpillars, but neither are gregarious species, or sufficiently plentiful to make any impression on the vast legions in which the caterpillar appears.

If the pest appeared in Ceylon I believe that good service would be done by the little white-eyed Tit (*Zosterops Ceylonensis*), a small greenish bird with a white ring round the eye. On up-country estates in Ceylon these little birds work their way about in the Coffee in large flocks, most carefully searching the leaves for spiders, insects' eggs and larvæ, aphides, etc.

I put four of the moths alive into a glass case with a big *Gecko Stentor*, but though they remained there for four days they were untouched, though cockroaches and grasshoppers also put into the cage during this time were immediately eaten.

Mason wasps and ichneumons are not sufficiently numerous to be of any use against such a plague of caterpillars. The former kill very few larvæ and of the 200 odd chrysalides which I hatched in captivity not one had been attacked by the latter.

Very heavy showers of rain at the time when the young caterpillars are hatching and in large quantities are apparently very destructive, washing the tiny larvæ off on to the ground in great numbers, when, unable to regain the foliage, they perish in the dust, or are destroyed by ants.

Probably warm sunny weather with occasional light showers is the most favourable to a batch of these pests. The heavy showers at the end of February did much to reduce heir numbers and the recent drought has also proved very unfavourable to the insects, the pupæ dying underground from want of sufficient moisture.

It is extremely rare for any of the Hawk Moth caterpillars to appear in numbers sufficient to make them an appreciable agricultural pest. The only other case in which I am aware that this has happened was that of the large Sphinx Caterpillars which attacked the Cinchonas in Ceylon some years ago.—A.L.B.

NOTE.—A certain amount of damage has however been recorded as having been done by the caterp llars of the Death's Head Moth (*Acherontia Atropos*) to potatoes in Europe.—H. N. R.

PARASA LEPIDA, CRAM. (*Limacodidæ*).

From Negri Sembilan MR. ASHBY sends me some larvæ found feeding on coffee leaves. They are about half an inch long, wood-louse shaped, armed with four lines of processes furnished with semi-transparent stinging hairs. The caterpillar is pale blue with four of the tufts, two at each end black, and a black spot on the anal segment. They seem to be the larvæ of a species of *Parasa* near *P. lepida* and possibly the same insect. These caterpillars I have seen feeding on various trees and shrubs, and they are very destructive. Some of the catreprillars of this group sting badly and are very troublesome to get rid of by hand picking. *P. lepida*, Cram., is well known in Ceylon as a coffee pest, and also in Java, where the caterpillar is known as Ular seret, Ular sintang, and U. sengenet. It forms a round brown papery cocoon on the leaf, and appears as a green and brown moth, an inch across or more.

As more than one of these *Limacodidæ* have been proved very destructive to Coffee, planters will do well to cause their destruction if they appear even in small numbers.

Castor-oil Caterpillars.

From Kajang comes an account of a very destructive caterpillar which attacked first the castor-oil plants which had been planted among the coffee bushes and which having eaten all the leaves off the castor-oil fell upon the coffee for want of something else to eat. The caterpillars are about an inch and a half long, nearly smooth, with only a few scattered short hairs. The head is smooth and shining mahogany brown, the forelegs the same, the body dark blackish brown with lighter mottling over the back, there are two yellow dots on the back just beyond the last pair of forelegs, and from the same position runs on each side an orange ochre line along the spiracles. On examining some castor-oil plants in the Botanic Gardens, I find what is evidently the same animal, but it is of rather a lighter colour, with a more distinct mottled grey dorsal band with a dark central line, the dots on the back white and the side stripe pale laterite red. These caterpillars had eaten all the leaves off the castor-oil, and had attacked then some *Clerodendrons* (*C. fallax*), *Gynura Pseudochina* and other succulent weeds. These caterpillars pupated May 2 to 4, without making any cocoon. The chrysalises were nearly ¾ inch long. The moths hatched out May 15th. Upper-wings nearly an inch long, light reddish brown faintly marbled with a dark brown sigmoid mark in the centre, a wavy line along the edge, edge crenate dentate, a line of black dots within the margin. Under wings dark grey, edge yellowish crenulate. Head and thorax light reddish brown, a blackish grey spot at the base, body smoky grey, tail yellowish. Wings and body beneath pale reddish fawn, a row of black dots across the centre of the lower wings and one along the edge. It is apparently a species of Ophiusa near O. cuprea.

Turmeric Moth. *Dadessa evaxalis.*

The caterpillar of this moth inhabits the stems of several of the turmerics cultivated as spices. It is about ¾ of an inch long, smooth except for fine scattered hairs on back and sides, the head and first segment black, the body of a pale semi-transparent pinkish colour, with grey or black dots on warts down the back, and a row just above the spiracles on each side, a pink line above the spiracles the whole length of the body. It makes a burrow in the leafy stem and can be detected by the exudation of the excreta from holes in the stem and the withering of the leafy portion. The chrysalis is about an inch long and remains in the tunnel bored by the caterpillar. The moth is an inch across the wings entirely ochreous yellow above sprinkled all over with black spots an short streaks. The body is long and slender and the legs and antennæ are long and delicate. On the underside the upper wings and a bar across the thorax are sooty.

If troublesome all stems attacked should be cut and destroyed before the moth escapes.

THE WOLF MOTH. *Tinea granella.*

A bag of rice brought to the Garden was found to be infected with caterpillars to such an extent that it was quite useless, the small dirty white grubs lived in the rice grains, and spun them together with a web, nibbling them to dust. Having pupated the moth came out in a few days. It was about half an inch long entirely smoky grey. When at rest it rolls up its wings so as to appear quite cylendric and resembles a small piece of greystick. I suppose it to be the well-known Wolf moth, a regular godown pest in all warm places. It is said only to devour white rice, and the treatment recommended is to sprinkle the rice with salt. If it becomes abundant in the godown, the rooms should of course be cleaned out and thoroughly cleared of the pest.

THE PUMELO MOTH, *Nephopteryx sagittiferella*, Moore.

A very complete account of this pest was published by Mr. WRAY in the Journal of the Asiatic Society, Straits Branch, vol. XIX, p. 83, and it was described and named scientifically by Mr. MOORE in Indian Museum Notes, vol. 2. The eggs are laid on the fruit, and the caterpillars eat into the rind, burrowing eventually into the fruit and causing so much injury that the fruit falls before it is ripe. When full-grown the caterpillars descend to the earth where they pupate, and 12 days after escape as moths. The moth is brown with shading of silvery grey, and is about an inch across.

I have seen what I suppose to be this animal in pumeloes in various places, and it quite destroyed all the lemons on a tree in the Botanic Gardens in Singapore some years ago. The most practical way of dealing with this animal is to constantly destroy all fruit attacked by it so as to prevent the caterpillars developing into moths.

THE PADI BORER *Chilo. sp* near *Ch. oryzœellus*, Riley.

Is also described by WRAY as destroying the paddy in Perak. lc. p. 73. The egg is laid on or at the base of a leaf and the caterpillar tunnels the stalk and the midribs of the leaves and leafstalks. It pupates in the stalk or the leafstalk and hatches out into a pale ochraceous moth, nearly an inch across. It is very destructive, destroying whole acres of paddy. It is reckoned that there are six broods in the year. A parasitic larva, one of the Tachinid flies was found to destroy a quantity of them. Destruction of the straw and of selfsown rice by fire, after the harvest was recommended. Another species apparently of the same genus was also found attacking padi by Mr. WRAY but it was rarer.

The Sugar-cane *Chilo*, was described in Bulletin No. 7, p. 143. The habits of all these grass borers are much the same. The caterpillar tunnelling the stem coming out at intervals and

burrowing in again and pupating in the stalk. The moths remain quiescent during the day and fly about at sundown or later.

The Gutta percha moth.

The Gutta percha trees in Singapore are commonly attacked by a small Tortrix caterpillar which spins two leaves together and devours the epidermis and causes the death of the leaves and often of the shoots as it usually attacks the terminal leaves of the shoots and includes the bud in its nest. It is a slender caterpillar half an inch long, smooth with a dark brown shining head and a greyish black body with shining darker spots all down its back from which spring hairs. It draws the leaves together by the edge and covers the open ends with a wall of brown silk from which when it pupates it hangs by the tail. The chrysalis is dark brown an inch long with a curious knob projecting from between the eyes. I have failed to rear the moth.

To the same group of moths belongs the Ramie moth described on p. 139 of Bulletin No. 7.

The Atlas Moth, *Attacus atlas*.

Is well known in the moth state to every observer here, as it is very common and our largest moth. The caterpillar is nearly six inches long and very stout, entirely of a pale green colour covered with a white bloom except for a pinkish spot just above the last pair of hind legs. It is quite hairless but is covered with large thorn-like processes.

The animal will eat almost any kind of leaves, but appears to prefer those of the custard apples. I have also found it eating Stillingia sebifera, Trevesia eminens and even gambier leaves, being the only caterpillar which I have ever seen eating the latter. Though never appearing in very great abundance, it is a very destructive insect on account of its great voracity. It will strip a tree of its leaves in a surprisingly short time. The chrysalis enclosed in an egg-shaped bag of yellow silk is spun on the tree on which it has been feeding. The moth with its large curved wings red with markings of white and grey, with a large rhomboidal clear space on each, its fluffy red body and plumed antennæ, is conspicuous hanging on the branches of bushes, or flapping slowly through the air. The male is always smaller than the female, which is often over nine inches across the wings. It is not attacked by birds and even monkeys will not eat it, probably on account of its peculiar musky smell. It lays a large number of eggs, about 300, they are firmly gummed to the under surface of the leaves (Indian Museum Notes II. 72.)

It is curious that with the immunity from enemies which both caterpillar and moth seem to possess, that the insect is not more injurious than it is. Ichneumons, however, I believe, destroy a quantity of the caterpillars. It may be stated that the silk of the cocoon though in itself good is so glued together that it is

impossible to unwind it and it is useless. Attempts have been made to use it however (Indian Museum Notes II. 72).

Coleoptera.

Nutmeg Beetles, *Scolytidæ*.—The small beetles described in Bulletin No. 5, as causing so much damage to nutmeg trees in Penang and Province Wellesley, have been identified by Mr. Blandford as comprising three species of Tomicidæ. Two of these are species of *Phlœosinus*, one of which is described as *P. cribratus*, Blandford, and with them was *Xyleborus fornicatus*. This latter has been reported as very destructive to tea in Ceylon (Indian Museum Notes IV, p. 57, Pl. V). It attacks the stems, riddling them as if a charge of snipe shot had been fired at them. Mr. G. Alston is quoted as saying that strong vigorous trees in good soil seem to be very little affected but poor plants on ridges or poor soil seem naturally to feel the effect of it quickly, though in no case have I seen a tree killed by it. Other species of the same genus are well known insect pests, and in cases of any of the shot borers being found attacking trees, care should be taken to burn all dead wood and bark on the ground to prevent the animals breeding.

Batocera Hector, *Dej.* (*Longicornia*).—This is a very large plain light brown longicorn beetle about 3 inches in length with long antennæ and a thorn on each side of the thorax, I believe I am right in identifying it with a rather common insect which often comes to light in houses, where I suspect the larva has previously fed on the timber. The grub is about 4 inches long, stout and white. It is reported (Konigsberger Dierlijke Vijanden der Koffie culter in Java) as being very destructive to the shade trees, chiefly Dadup *Erythrina*, and less frequently to *Albizzia* and nutmegs.

Serica sp? near *S. pruinosa* (*Lamellicornia*).—From Tapa in Perak I have received some small brown chafers which Mr. Bailey tells me have done a great deal of damage in devouring the leaves of Mango stem and Rambutan trees, quite defoliating them. These insects fly only at night, hiding probably in the ground during the day. The beetle is a quarter of an inch in length, entirely smooth, shining chestnut brown, the head is small, thorax rather short, elytra rounded dorsally almost completely covering the body and finely striate, the legs long and slender especially the hinder pair which project beyond the abdomen.

Two species of small chafers about a quarter of an inch long are very troublesome in gardens in devouring leaves of many shrubs such as Acalyphas and biting every leaf into holes.

These beetles attack the plants only at night when a visit to the shrubs with a lantern will show them to be swarming. They can be shaken off into a net or cloth but fly very briskly and many escape. One of them is entirely glossy black the other brown with faint mottlings. During the day these beetles probably hide in the ground and I have several times dug them up beneath the bushes they have been eating but only a few at a

time. Where the greater number vanish to during the day I am unable to discover. They are by no means universal in gardens, though widely distributed. On some gardens every bush is eaten by them, in others they are scanty or absent. Specimens sent to the British Museum were unknown to the entomologists there.

Other destructive lamellicorn beetles we have here are the black coco-nut beetle *Oryctes rhinoceros* described in the Journal of the Straits Branch of the Asia Society Vol. 20 and the big *Xylotrupes Gideon* L. found damaging sugar cane in Province Wellesley (Bulletin No. 7, 144) and stated to attack coco-nut in the same way as the black coco-nut beetle in India (Kew Bulletin March 1893) and *Lachnosterna* sp. the sugar chafer (Bulletin No. 7, p. 144).

Bamboos cut for building purposes, etc., are very apt to be destroyed by several species of very minute beetles which soon reduce them to powder This is however very easily prevented by soaking the bamboos as soon as cut in a pond or tank for a fortnight putting weights on them to keep them down. When taken out and put to dry they exhale a very unpleasant odour for some days but this soon goes off and the beetles will no longer attack them.

In the group of long-snouted beetles known as Weevils (*Curculionidæ*) we have several very troublesome insects. THE GRAIN WEEVIL *Sitophilus oryzæ*, a very small black narrow weevil always found in rice and other grain when stored in the godown is as abundant here as it is nearly all over the world. Many plans have been suggested for its destruction. Among other plans for its prevention it was the custom in Brazil to store the grain (Indian corn) in cement tanks and cover it with a thick layer of sand which seemed to prevent the animals getting at the corn from the ontside or escaping if they were already in.

ASTYCHUS CHRYSOCHLORIS Wied.—This green weevil was reported by Mr. WRAY, Perak Museum Notes II, 1, 1897, as doing great damage to the coffee on Gapis estate, and what I take to be the same thing was sent me some years ago as defoliating nutmegs. It was found also in Perak eating Dadup (*Erythrina*) Durian, Guava, Hibiscus, Limes, Pumelos, Orange, Mango, Bachang (*Mangifera foetida*), and the wild Bombax and some other plants. Mr. WRAY gives a full account of the life history of the beetle which is briefly that the egg is laid in the ground and the grub which apparently feeds on decayed vegetable matter till it grows to about ¾ inch long, forms a chamber in the earth, and pupates there about two inches below the surfa e, hatches out at night and feeds on the leaves; after about a month it breeds, the egg being laid over a month afterwards. As the beetle continues to eat the whole of the three months or more it exists, and does not leave a tree till it has eaten all the leaves it can, it is very destructive when abundant. It does not fly readily but can be shaken off the trees and was destroyed by hand-picking. The insect is easily known by its bright green colour covered

with golden scales easily rubbed off, and is about half an inch long. It is common in many other places besides Perak, but I do not remember to have met with it in Singapore. Mr. WRAY gives its name as perhaps *A. lateralis*, but from the figures of *A. lateralis* and *A. chrysochloris* in Indian Museum Notes, I take it to be *chrysochloris*.

THE BANANA WEEVIL, *Sphenophorus sordidus*, Schonh.—This is a very destructive insect and one not at all unlikely to be overlooked. The larva burrows in the stems of the plantains, often quite at the base, the stems cease to grow, become weak, the leaves turn yellow and the whole stem perishes. When the beetle is abundant the stems are attacked as fast as they push up, and eventually the whole plant dies away. On being split up the stems and leaf sheaths are found to be tunnelled vertically and transversely, grubs and pupæ are seen in the tunnels, white the full grown beetle is hiding beneath the sheaths, or often in the ground at the foot of the plant. When the plantation is thoroughly infested, which happens very quickly after the beetle makes its appearance, the pest seems almost impossible to eradicate. The only thing to be done is to cut the plantains down to the ground take out the stump, clean it thoroughly and replant it in a different plot of ground. All dead stems should be broken up and destroyed as the beetle will go on living in them till quite rotten. All plantain growers should look over their plants at times to see that the pest has not made its appearance, and when stems are seen to be unhealthy looking, cease their growth and fail to give fruit, the leaf sheaths should be stripped off when the beetle will probably be found. The beetle attacks all kinds of cultivated plantains, but the common Pisang Kelat though not absolutely proof against it is much more rarely attacked than other kinds, and I have seen this variety standing unhurt when all other kinds surrounding it have been destroyed. The Manila Hemp, *Musa textilis*, is also attacked by it, but to a less extent than the eating plantains such as Pisang Mas.

The beetle is half an inch long, rather flat, entirely black and shining. Its curved snout is $\frac{1}{8}$ inch long, the head very small, conic. The antennæ longer than the snout bent and clubbed at the ends. The thorax is rather narrow, oblong, conic, polished, black and dotted. The wing cases $\frac{1}{4}$ inch long and $\frac{3}{16}$ inch wide blunt and rather narrow grooved and ridged, shorter than the abdomen, the legs rather long with sharp spurs near the feet. It is sluggish in habit, and only creeping slowly about when disturbed. The grubs are about half an inch long, white with a red-brown head, of the typical weevil form, *viz.*, fleshy and curved, thickest in the middle and tapering at the tail, with powerful jaws and no legs. The pupa is enclosed in a cylindrical cocoon of fibres of the plantain. In fact both grub and pupa closely resemble those of the red coco-nut beetle, but on a much smaller scale. Together with the common black kind I found another kind *S. planipennis*, Schonh, which, however, is much rarer, in which the body, head and thorax were red with black markings.

The black one is abundant in Singapore and also I have seen it in Selangor.

To the same group of beetles (*Curculionidæ*) belong the red coconut beetle *Rhynchophorus ferrugineus* described in the Strait Asiatic Society No. 20. The West Indian palm weevil *R. palmarum* has been made the subject of a very valuable paper by W. F. Blandford (Kew Bulletin, Feb.-Mar. 1893, p. 27-60) where there are many useful notes on dealing with these pestilential insects.

Recently a note was published in the *Ceylon Observer* and reprinted in the *Government Gazette*, as to the cleaning of a badly infested estate in Ceylon, and mention was made of the successful plan of cutting into infected trees and removing the larvæ of the red beetle, the wound being afterwards treated with tar. This has long been the practice in the Botanic Gardens and many valuable palms have been saved in this way. The plan adopted was to cut off the leaves one by one till the bud was exposed and the beetle grubs in the surrounding tissue destroyed. A cylindrical cap or bag was then placed over the top of the palm, to keep off the rain and removed when the next leaves began to push it up. No tar or other disinfectant was used. Of course care must be taken not to injure the growing point of the palm, but it is surprising how boldly one can cut into the bud without killing the tree. A fine *Oreodoxa regia* containing upwards of a dozen grubs was lately operated on and in a very few months showed no signs of the very severe operation it had undergone, The red beetle appears to be very partial to Sago palms, and breeds rapidly in the waste bits and the top and stump left by the sago cutter. Sago palm groves when being worked are apt to develop into an extensive breeding ground for these animals. They seem to do but little harm to the plant itself, though at times they do kill a few shoots. The tops and waste bits left in preparing Sago should be split up so that the beetles cannot breed therein. The most difficult thing however is to deal with the bases of the stems in the ground as they cannot be easily removed without injuriug the side shoots; they should be scooped out as much as possible when, if water settles in the cavity, the beetles will not come.

Hemiptera.

The red cotton bug.—*Dysdercus cingulatus*, Fabr. is a very conspicuous and brilliant bug about half an inch long. The head thorax and upper part of the wings red, with the scutellum and a spot on each wing black, lower half of upper and lower wings, legs and antennæ black, body red with white rings. This insect which is very common, attacks cotton plants, piercing them with its beak and sucking the juices. It feeds also on other *Malbaceæ Hibiscus abel moschus*, and *Urena lobata*, and is said also to attack Bottle-gourds in India.

The Rice Sapper.—*Leptoc orisa acuta Thumb.* is mentioned by Wray, Perak Museum Notes II, p. 60, as occurring in Perak. I

have also seen what I take to be the same thing in Malacca. It is a greenish long-legged bug about an inch long, very variable in colouring. While it is in the young wingless state it sucks the juices of the stem causing it to wither. The adult settles on the rice and sucks out the juice of the seed itself. (India Museum Notes, Vol. I, p. 1). What I take to be this insect is very common here in long grass, and I find it always on plants of *Panicum plicatum*, grown in the Botanic Gardens. The male, however, is much darker than any forms described in the latter publication, the wings being quite dark brown, edged with green, the body green. It emits the usual horrible odour of the ordinary bugs.

Hymenoptera.

Rose sawfly.—*Hylotoma victorina*, Kirby. Very destructive, occurring in great quantities, devours the leaves. Caterpillars when full-grown ½ an inch long, smooth with a few scattered bristles especially on its head. Head round, shining greenish brown, body green with black spots on the back in about 7 longitudinal rows, 6 forelegs long, the others short, side flaps 4 with black spots. At rest it curls up its tail like most sawflies and when walking drags it behind as if injured. It forms a net work cocoon of fine silk ⅜ inch long in which the chrysalis remains about a week and then hatches out. The fly is ¼ inch long, the head and thorax shining blue black, abdomen yellow and shorter than the wings, which are black. The antennæ rather stout and as long as the thorax, cylindrical blunt black, the legs short black. It may be found sitting on the leaves of the rose bushes and being very sluggish is easily caught.

It is destroyed by hand-picking.

A species of leaf-cutter bee (*Megachile*) also sometimes attacks rose bushes, cutting semicircular pieces out of the leaves to make its nest with a tube-shaped structure concealed in the ground. The insect is not very common but sometimes occurs in sufficient abundance to quite spoil the appearance of the rose bushes.

The carpenter bees *Xylocopa* often do a good deal of damage to timber, especially rafters and poles by boring into them to make their nests. The most destructive is the large black one, *X. latipes*, but much injury is often caused by the smaller one *X. oestuans*, of which the female is black with a yellow thorax, and the male light brown. They should be knocked down and killed and their holes blocked if found doing much damage. All however do a good deal of useful work in fertilizing many plants especially those with large flowers, so that unless absolutely injurious are best left unharmed.

Ants.—One often hears from planters of trees being destroyed by ants, but it may be very much doubted as to whether in these cases the ants have anything at all directly to do with the death of the tree, but where from decay or other cause a hole or tunnel is produced in a tree, ants often utilize the perforation as a suitable position for a nest. This is commonly the case where

boring caterpillars have been. When the moth or beetle escapes and flies away, ants frequently occupy the boring, and might easily be accused of having produced it. We are fortunately free from the leaf cutting ants, which are so destructive in South America, and I have not as yet seen any species which devours foliage of any kind.

Some ants are undoubtedly friends to the planter while some are foes, others do both harm and good. The best known ant here, the Keringga, *Formica smaragdina,* which makes its nest by weaving together the leaves of the tree it inhabits, and which is so well known for its pugnacity and its sharp bite, must be classed with the latter. Its presence on a tree usually evidences the presence of one or other of the blights, (*Coccidæ*) and if that is destroyed the Keringga soon quits. I have, however, little doubt that it carries the coccidæ about and puts them on trees, for I have several times seen cocci, lying loose often on their backs in the nest, in a position not at all natural to them, they having evidently been brought from elsewhere and dumped down in the nest to serve as food supplies for the ants, who as is well known obtain from these insects a sweet exudation of which they are very fond. Again in the tunnels made by borers and later occupied by ants, it is not at all uncommon to find blight in a position which it is in the highest degree improbable that these insects should have got of themselves. It is needless to say that as the blight represents the milch cows of the Keringga the latter does not kill them but rather protects them. In this way this ant may be said to be injurious. Another objection to it is its ferocity as when it is abundant it makes the gathering of fruit or pruning almost impossible. It may also do a small amount of damage by bending the leaves together, and causing arrest of their growth or death.

It has, however, some good points in its favour, and the chief of these is its ferocity towards caterpillars. Only specially protected caterpillars can live on a tree infested withKeringgas, and it has been found sometimes advantageous not only to leave the ants' nests on a fruit tree, but to put fresh nests on the tree to induce the ants to destroy the caterpillars. When it is necessary to clear the trees of the ants the nests should be broken with sticks when the larvæ and eggs will fall to the ground and be lost or eaten by other animals, and this unless there is much blight generally gets rid of them. Another plan is to hang pieces of meat on a string from the branches, the ants will come to eat it and can be destroyed by dipping the meat into boiling water, or what is easier applying a damar torch to them. In this way myriads can be killed. The ordinary insecticides such as Paris Green may also be used, but it will be necessary to break the nests up first or the ants will retreat therein and escape the spray. Another very small black ant may often be seen traversing the paths in long rows, having previously thrown up a line of earth on either side of their track. Their nests are in the ground, and they go out to forage along the track for some days. These ants

capture and carry off to their nests all kinds of insects and other small animals. I have seen them carrying off millepeds, and small snails; and on one track I counted as many as ten snails at once being carried along in the space of about two yards, and this destruction was going on for several days at the same rate. They also destroy large insects by attacking and biting them to death.

A very similar if not identical species however destroys as well any small seeds which they come across, carrying them down their holes and biting portions off them, eventually throwing out again the relics of the destroyed seed. Any seed as big as rice or smaller is eaten in this way, and this is probably the reason, why it appears to be impossible to raise grass turf from seed successfully here. Any one who has tried this must be surprised at the way that however much grass seed is sown on properly prepared ground, little or none comes up, even if covered so as to prevent the grass-finches from eating it. Where small seeds such as Ramies or *Ficus elastica* or even larger seeds are sown in the nursery; the planter is very apt to lose a large proporton if there are many of these ants' nests in the neighbourhood.

These terrestrial ants may also do some damage by piling up mounds over young plants. They however do some amount of good to the soil, at least in some cases, by turning it over and breaking it up, but as a rule they are not abundant enough to be of much use in this way.

Orthoptera—The Coffee Locust.

Cyrtacanthacris nigrovaria, Walker.

The coffee locust (*Cyrtacanthacris nigrovaria*, Walker) is a very common and conspicuous insect occurring all over the Peninsula from Singapore as far North as Perak and Penang. It is about 3 inches in length with a large head and conspicuous eyes the antennæ slender ¾ inch long black, the thorax ½ an inch long, and both it and the head are light yellowish green with black spots on the sides above blackish grey with a broad yellow line running from the base of the antennæ down the back, the upper wings 2 inches long, are greenish brown, finely netted, and the upper edges are greenish yellow, so that when at rest the yellow band on the head and thorax continues along the edge of the closed wings; the lower wings are broad and transparent tinted and veined with brown, except the bases which are pink, and very conspicuous when the insect flies, the abdomen is dull greenish brown, shorter than the wings. The first two pairs of legs are short and blackish green. The hinder jumping pair very large and powerful, the thighs (femora) an inch long very thick at the base and tapering to the tibia greenish yellew, with two broad bands and the end black at the joint which is dilated somewhat are two yellow flanges, the tibia is an inch long black and armed on the back with a double row of yellowish thorns with black tips, the tarsus is short, a quarter of an inch long with

four small pads at the base, and a terminal one with a small claw on each side.

The female much resembles the male but may be known by its possessing an ovipositor.

The young locusts are apple green with yellow spots, rather soft bodied and wingless.

The young locusts live in low scrub and long grass and are not very conspicuous. They feed on leaves, but rarely do any damage to cultivated plants. The adult, which is a powerful and active insect, can often be seen in similar places, taking short flights when disturbed, but rarely going more than 20 yards at a time. Like the young it eats leaves, but seldom attacks coffee or tea with enough voracity to do harm. I have, however, detected it in the act of biting young Para Rubber plants, and it might in this way do much harm. It is very injurious, however, to many plants, from its habit of laying its eggs in slits cut with its ovipositor in twigs of various trees. The eggs, which are white cylindrical objects about $\frac{1}{8}$ of an inch long, are deposited in considerable numbers in short slits cut in the bark in a spiral manner, the locust going round the twig from the lower part upwards and laying the eggs as it goes. The twig very speedily dies, and falls off. The larvæ on hatching out usually leave the tree on which the eggs have been placed and betake themselves to the neighbouring grass and low scrub where they feed and develop. The coffee locust commonly attacks the coffee in this way, and I have also seen tea damaged by it, and from one estate in Selangor I received a collection of twigs also of guavas and other fruit trees and even fronds of ferns which had been destroyed in this way. Not long ago also I found an orchid in the gardens, in each one pseudobulb contained a double row of eggs of this or an allied species arranged in two rows in a long slit in the bulb. This however may have belonged to a different insect as the eggs were larger than usual and brown, and when they hatched out the young locusts were entirely green with long antennæ. They refused to feed and soon perished.

Though this locust must do a good deal of damage when abundant, it is usually neglected, even if pretty common on and about almost every coffee estate. A watch, however, should be kept on it to prevent its becoming too numerous, and it should be killed whenever seen. It is a clumsy flier and can only go short distances at a time, so that it can easily be knocked down with sticks by children and if too abundant the low scrub and lalang near the fields should be cut down and burnt to destroy the young ones which feed there.

Crickets.

Some specimens of a cricket which had been doing damage by biting off the tops of young rubber plants near Klang were sent me by Mr. Darby. They are like most of these animals nocturnal, remaining in holes during the day and coming out at night to

feed. These specimens apparently belong to the species, *Gryllus testaceus.*

The animal is about an inch long. The head is broad and rounded, with large eyes, the antennæ very short, ¼-inch long, the palpi as long. Thorax broad, abdomen thick, about ¼-inch across, wings ¾-inch long, dark brown with numerous cross nerves, the hind wings prolonged into long points. The legs semi-transparent brown, first two pairs comparatively short ¾-inch, hinder legs very long 1½-inch, the first joint broad and stout, the second covered with strong thorns. The ovipositor is one inch long, slender, slightly curved, dilated at the tip. Two processes half an inch long project from the tail.

Few classes of insect pests are more difficult to deal with than crickets, living concealed all day in holes in the ground, they are difficult to find, and as they are often very voracious may do a great deal of harm in one night. It is however in the nursery beds that crickets are most destructive. They seldom ever do harm to trees which have grown two or three feet tall. If they are abundant in the field, it will be safer to defer planting out very young plants, and to wait till they are old enough to withstand the attacks of the crickets. Near the nurseries, rubbish and old logs in and under which these insects conceal themselves should be destroyed, and grass and bushes cut back. Flooding the ground so as to drown then out of their holes might be tried in serious cases, but as a rule keeping the ground clean of any rubbish will be sufficient to protect nursery beds.

Neuroptera.

Termites.—Termites or white ants as they are popularly called belong to the order *Neuroptera*, and have nothing to do with the true ants (*Hymenoptera*). They are exceedingly troublesome in many ways to the planter, and are often accused of destroying living plants directly by devouring the roots. Remarks on this action here have already been published in a previous bulletin, No. 2, p. 78. The question has been raised again lately in the Agricultural Ledger No. 18 of 1897, where a note from the Settlement Officer of Balaghat as to Mango saplings being attacked by white ants is printed. The Officer in question lost a number of saplings, and on investigation, found an apparently otherwise healthy tree with the roots eaten through in places "and a detachment of the voracious termites was actually pushing its way up the heart of the sapling eating its way through perfectly good juicy wood." Unfortunately no attempt seems to have been made to identify the species. The number of different species of termites is probably exceedingly large, and the group has been but little studied by any one except Dr. Haviland, whose paper (Journal, Linn. Soc. pp. 358 to 442) is the only one of any importance dealing with the Asiatic species. As might be expected the habits of the different kinds are very varied and whereas some kinds may and indeed do attack

healthy trees, others and far the greater number undoubtedly do not do so.

The only one I have met with here which is directly fatal to living trees is *Termes Gestroi*, WASMANN, a very curious species. It is a yellowish coloured termite with very powerful overlapping curved jaws with sharp points and it is also provided with an aperture in its head from which, when annoyed, it can exude a white milky liquid. It attacks trees by covering the trunk out side with a thick layer of mud from the base to about ten feet from the ground destroying the bark and burrowing into the wood through weak or dead spots and forming a nest of wood fibre inside. I have never seen a tree recover from the attacks of this animal although the mud has been repeatedly scraped off, the injured surfaces tarred or covered with other substances injurious to the insects. The workers contrive to cover the tree again and again with mud in a very short space of time, and the tree very soon dies. In a large bush of *Mimosa sepiaria*, which was attacked by this insect, or one closely allied to it, the whole tree was permeated by their tunnels, and even very small twigs when broken were found to have mud carried into them, and it was remarkable that though this was the case the tree outwardly appeared completely healthy, covered with leaves and bearing flowers and fruits. Specimens found destroying para rubber trees have been sent me lately from Selangor. It was perhaps a species allied to *T. Gestroi* that the Settlement Officer found attacking the Mango saplings. *T. Gestroi* however is by no means a common species, and seems rather to frequent woods than to appear in open ground, as the well known mound building species *T. Malayanus*, Hav. the best known species here does. This latter species is the one usually accused of destruction of various shrubs and trees, but I have never seen any signs of its ever biting living wood or roots. In cases in which roots of grass, orchids or trees traverse the nest they are walled out with a layer of mud and on carefully removing this the roots are seen to be quite uninjured. Any one who has examined a dry wood by night and noticed the immense abundance of termites running about everywhere beneath the leaves, would soon come to the conclusion that if they did attack living trees or shrubs the forests would be speedily destroyed, yet it is very rare to find a tree that one can suspect of being killed by them, as mentioned in a previous bulletin. *T. Malayanus* and other dead wood feeders can kill trees indirectly by removing dead portions and exposing living portion to the action of wet, and in other such ways, but this is really only hurrying on the death of a diseased tree. The very conspicuous black termite, *T. hospitalis*, which can often be seen marching in lines of extraordinary length, the workers bearing balls of nibbled bark or dead wood, the soldiers with their heads drawn out into sharp beaks, flanking the march, sometimes damages large trees by making their nests in the forks or between the roots, and indirectly producing decay of the tree. The nest which is quite exposed is easily cleared away and is not usually rebuilt.

In India, it is stated that *T. taprobanis*, Walk. an ally of *T. Malayanus* is very destructive, devouring stacks of corn, etc., and young unhealthy plants, and may be the white ant which destroys the sugar cane, burrowing into and destroying the sets as soon as planted eating "through the junction between the young plant and parent set so that the latter withers off. The remedy always applied is Castor-cake" which is applied powdered to the roots of the canes to the amount of between 1,500 lbs. and 2,000 lbs. per acre, chiefly as manure but it also keeps off white ants (Agricultural Ledger.)

I have found it sometimes very difficult to get rid of *T. Malayanus* especially where it has made its nest beneath a road, where it is very troublesome, forming cavities beneath which collapse suddenly when a horse passes over it. The nest may be dug out, and the queen destroyed by a fire made in the cavity and tar, etc., poured in, yet the nest is again and again reconstructed. Very often however they will go away if decaying animal matter, such as night-soil is poured into the ground where the nest is.

PARA RUBBER NOTES, II.

Mr. CURTIS, in the annual Report of the Penang Gardens for 1898, makes some remarks on his observations and experiments on the Para Rubber trees in the Penang Gardens, which are worth the attention of those interested in Rubber cultivation and as the annual Gardens reports seldom find their way into the hands of planters I reproduce the notes. He writes:—

"I have again tapped the best tree in the garden from which 1 lb. of rubber was taken during the rainy season of June, 1897. A sample of this was subsequently sent to Kew and submitted to Messrs. HECHT LEWIS and KHAN, for valuation, who reported it as "beautiful rubber, very well cured worth to-day (31.8.98 3-3 per lb." This had simply been dried in the sun and kept in the office for about a year. Being planted on dry gravelly soil this tree grows less rapidly here than those that are planted in moister and more suitable soil in Perak and elsewhere. At two-and-a-half feet from the ground it forks and the main stem measured at three feet from the ground in June, 1897, had a girth of thirty-six inches. Measured again in December, 1898, after an interval of 18 months, it had increased five inches in girth and the cuts had quite healed up. This tree is 13 years old. This time the tapping was commenced on the 16th November which is generally about the end of the heavy rains, but there is here no season which can be counted on as absolutely dry as in Burmah and India, and, in fact, rain fell frequently while the operation was carried on, which was spread over a period of thirty-four days. Oblique cuts leading to perpendicular channels were made in six places subsequently increased to seven, at the bases of which were fixed by means of a lump of clay and a nail small tins to receive the latex. An ordinary carpenter's

chisel was used for making and renewing the cuts. At the beginning the milk comes slowly and at no time continues running for long. With two exceptions the cuts were renewed between 7 and 8 A. M. and the tins brought in at 11 A. M. but the flow had ceased before that time. The two exceptions were when the operation was performed in the evening, but as there is always a danger of rain during the night and a very slight shower causes water to flow into the tins as nearly all the water trickling down the stem of the tree falls into the oblique cuts and is thence led directly into the tins the work is best done in this climate in the morning. Generally the latex had coagulated by the following morning, that is after standing about twenty hours but on two occasions only partially so. In these cases and also when rain water had got in the tins a pinch of powdered alum was added which caused perfect coagulation in a short time. If the addition of alum does not affect the value of the rubber it facilitates working operations in wet weather for a little water getting mixed with the latex does not matter provided the vessels do not overflow. All the rubber can be recovered by the addition of alum. On the morning the incisions were first made only $\frac{1}{4}$ oz. of wet rubber was obtained but by taking a thin shaving off the lower surface of the oblique cuts on fourteen subsequent occasions the following quantities were obtained at each operation, in ounces $\frac{3}{4}$, $1\frac{3}{4}$, $3\frac{1}{4}$, $3\frac{1}{2}$, $3\frac{1}{4}$, 6, 9 $6\frac{1}{2}$ $8\frac{1}{2}$, 6, $6\frac{1}{2}$, 10, $8\frac{1}{2}$, 8. Total 5 lbs. $1\frac{1}{2}$ ozs. of wet rubber which weighed when dry exactly 3lbs. As will be seen from this the last three tappings gave a better result than any previous three, the operations were only suspended as it was not advisable to make the cuts any wider. The time occupied in affixing the tins and renewing the cuts averaged half an hour on each occasion or $7\frac{1}{2}$ hours in all. It may therefore be taken that a man at say 30 cents a day could attend to at least fifteen trees a day, and that the cost of collecting it will not exceed 10 cents per lb.''

The alum, however, seemed to me to have an injurious effect on the rubber, making it soft and had better not be used.

Mr. Willis, in letters written to me, points out two errata in my quotations from his Bulletin, in the Gardens Bulletin No. 8, p. 230. The 45 trees at Heneratgoda were twenty-one, not eleven, years old, and the trees of 2 feet mean girth gave only 5.17 ounces not lbs. He also states that the popular idea that Para rubber cuttings die in a few years is a fallacy. He says ''Some of the best Para rubber trees here are from them and 12 to 15 years old. I fancy cuttings of *lateral* branches will not do so well. This is what one would have expected from evidence here, but certain persons have been constantly stating that in Ceylon trees from cuttings have always died in the fourth year. It is regrettable that would-be instructors in planting are not more careful in their facts. Undoubtedly Para rubber is not very easy to strike, but when well rooted the cuttings seem to be as good as any other plants. Recently it was noticed in the Botanic Gardens here that some sticks of Para Rubber about 4 feet tall and

an inch through which had been used as props to support other plants had thrown out shoots and begun to grow as readily as such cuttings of Angsana and Erythrinas do.

Abnormalities in *Para rubber trees*.—The capsule of the Hevea, like that of most Euphorbiacea contains three seeds and is three-lobed. One fine tree in the Botanic Gardens, however, produces a large proportion of four and even five-lobed fruits, containing four and five seeds respectively. A curious variation in the form of the leaf in young plants was seen at Pataling and elsewhere in Selangor. The lobes of the leaves instead of being oblanceolate were remarkably long, almost linear and narrow.

In big trees which have been cut or broken down it very often happens that the leaves produced on young shoots are of unusual size but generally of the ordinary shape.

Soils.

Recently Mr. Willis wrote to ask for samples of the soil in which the Para rubber trees were growing in the Botanic Gardens, with a view of having them analysed. He kindly sent me a copy of the analysis by Mr. Hughes. It is well known that in this soil the trees have grown remarkably well, and this analysis may help to determine the very best soil for this cultivation, so with his permission I append it. When compared with the ordinary clay soils of this part of the Peninsula it will be noted that there is a much larger percentage of organic matter containing nitrogen, and a corresponding diminution in silica and iron. The ground from which this sample was taken is low-lying and damp, water occurring about a foot below the surface. It was evidently originally swampy jungle, which being cleared was put under indigo till, in 1884, the land was taken over by Government, and the Rubber planted. It has never since it was under indigo been manured, but, a certain amount of manure, or salts derived from it may have been washed down from beds higher up on the hill. Earthworms are tolerably abundant where it is not too wet and termites are almost absent. With respect to the lime which is rather more abundant than in most of our soils, I note that the soil is so deficient, that the small spiral snails (*Stenogyra*), are reduced to nibbling the dead shells of a species of Helix in order to supply themselves with the necessary lime for their shells.

Analysis.

Composition in the air dried condition :—	
Water (lost @ 212° F.) ..	.. 6.288
Organic matter and volatile combustible	.. 27.541
Substance (containing nitrogen)—	
Oxides of Iron	.. 3.198
Alumina	.. 8.526
Lime	.. .272
Carried over	.. 45,825

Brought forward	45,825
Magnesia	.028
Potash	.093
Soda	.147
Phosphoric acid	.181
Sulphuric acid	.034
Carbonic acid	traces.
Nitric acid	.001
Chlorine	.007
Silica soluble in alkali	12.049
Insoluble silicates and quartz containing coarse sand separated by washing	41.635
	100,000

(Signed) JOHN HUGHES, F. I. CH.,
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April 28th, 1899.

THE RESULTS OF the RESEARCHES OF MR. PARKIN and Mr. WILLIS, on the latex of Rubber-trees have now been published and will doubtless be read by every earnest planter. The paper contains a great deal of interesting information and many original observations and suggestions which are well worth considering. Great stress is laid on the preparation of rubber from the latex by centrifugalization and chemical processes. Separation of the rubber by centrifugalization was first experimented with by Mr. BIFFEN, in Mexico last year, and further experiments were carried out in Ceylon. Para rubber does not seem to work well with the machine, requiring a somewhat high rapidity to separate it, but the plan seems to be very successful with the latex of Castilloa and perhaps it might also be used with some of our more liquid native rubbers. It is stated that a company has been started in Mexico to produce commercial rubber by centrifugalization. "The advantage" say the authors "of this new process are obvious. The rubber can be obtained practically pure from the latex without the admixture of proteids, etc., hence no liability to decay. Since the Caoutchouc particles are obtained in a thick cream which can be spread out on a porous surface, it allows of the rubber being prepared quite dry in a short space of time."

Now in the Straits Para rubber sets solid almost directly after the latex is drawn off from the tree. To obviate this it is requisite to add a little ammonia and water to keep it liquid, it is then filtered twice, heated nearly to boiling point with some acetic acid and creosote, and then cold water is poured into it when the rubber collects in clots which are to be pressed out in thin sheets on a porous surface and dried off. It naturally occurs to one on reading this that though it is probable that a very superior article may be procured by this means the expense of pre-

paring it will be at least doubled, and that it may be doubted that the price of commercial rubber even of a better quality than has ever been turned out previously will rise in proportion. Undoubtedly the manufacturer should try to produce the best product he can make subject to the exigencies of expense but it must be remembered that ever since it has been used rubber prepared in the ordinary method without machinery or chemical processes has been used for every conceivable purpose, and that there will always be a demand for a comparatively cheap serviceable article. If the process as applied to Para rubber removed all the proteids from the latex it would easily be understood that it would make the rubber more durable but the authors explicitly state that it does not do so, the proteid remaining to a large extent in the rubber.

The proteid undoubtedly does putrefy and give off an evil odour during drying but this does not seem to affect the rubbers lasting qualities at all. Specimens have been kept here for years which although they originally had a foul smell and had even at times been mouldy on the surface, due to the wetness of our climate, yet at the end of the time are as good as the best home rubber in every way, that is to say as good as the manufacturer requires.

One suggestion to use creosote to prevent the growth of moulds in rubber, seems well worth trying. This would probably prevent the decay of the proteid, and any injury to the Caoutchouc which may be causd by this.

I have criticised the suggestions in this paper not to recommend the planter to turn out any cheap rubbish, but rather to prevent his being deterred from planting Para rubber by the idea that expensive machinery or an elaborate chemical process is necessary to turn out a good commercial product. Rubber is now at its highest price, and its uses increase every day, enormous quantities being used for a very large number of purposes. All this rubber is prepared in the ordiary manner without machinery or chemical process and is found quite suitable for these purposes.

Undoubtedly these processes may be most valuable for bringing into market, other very liquid rubbers which at present are valueless and it is certain that we shall be able to improve our Para rubber in many ways and turn out an article better than the rough jungle-gathered rubber which has been the chief material in the hand of the manufacturer, but the principle of preventing para rubber from setting naturally by adding ammonia and then resetting it by the addition of acetic acid does not seem to present any very clear advantages.

The paper also includes figures of a tin vessel proposed for collecting the latex in It is a semi-cylindrical tin flattened on the side next the bark, above it is luted to the bark by some substance to prevent the latex escaping. There is no lid to prevent dirt or rain getting into the cap and the luting is inconvenient and clumsy. In fact the apparatus is by no means as good as the

cigarette tin suggested in Bulletin No. 7, which excludes every fragment of dirt and all rain even in a heavy storm, and by pushing a little mud between the side of the tin and the trunk so as to tilt up the bottom, or merely placing a leaf in the mouth of the cup, all the latex runs directly into the tin and none is lost.

KICKXIA AFRICANA.

A very important article on this little-known Rubber tree appears in "Planting Opinion" of April 8th, 1899, under the signature of "An occasional correspondent." The plant itself has been introduced into the Botanic Gardens in Singapore where it seems to grow steadily, though not with the surprising rapidity of an *Hevea*. *Kickxia* is by far the most important rubber plant of West Africa, though the rubber vines *Landolphia*, closely allied to our *Willughbeias*, and some species of *Ficus*, produce commercial rubber. It is a tree belonging to the order *Apocynaceæ*, and allied to *Mascarenhaisia*. The flowers are produced in the dry season, and at the same time the fruits developed from the previous years flowering are ripe, and splitting let free the plumed seeds, which drift away through the woods. As the correspondent observes the greater part of the seed is wasted by its not reaching the ground, and urges, reasonably enough, that the local Governments should encourage the gathering of the seed, and planting of it in suitable places. "The seeds, if carefully kept, preserve their vitality for a considerable time. It thrives best in a sandy clay with a sub-soil of clay, I have seen it flourishing in stiff clay but with feeders only partially buried. In quite a number of clearings in West Africa I have seen it growing luxuriantly as a sapling in loose friable sandy loam, although I must admit it had a tendency to be rather branchy, remediable, however, by judicious pruning. I should say the ideal soil for a plantation would be a loose sandy clay with more sand than clay and a sub-soil of clay. I know for a fact that the soil and climatic conditions are eminently favourable in the Straits Settlements."

The tree attains a height of 70 or even 80 feet, and in the forest it does not branch or bifurcate, but the author points out that in growing in the open it requires pruning, and if necessary can be stumped. He describes the method of tapping which does not differ from that in use for *Hevea*. But he points out that in the careless cutting by the aborigines, thousands of trees have died from exhaustion and deprivation of the chance of bark healing and recuperation by unreasonable tapping and unnecessary deep scorings through the bark into the wood of the tree rendering it an invitingly easy prey to a destructive grub with a predilection for the wood of the Kickxia and a prolific fecundity that is simply astounding. To preserve the tree against this damage he recommends an antiseptic plaster of one part of quick lime, two parts of wood ashes and five parts of clay.

Though at present we have seen no such damage to tapped Para-rubber trees, planters will remember that there is the risk

of attacks on the exposed wood of the cuts both by wood boring beetles and fungi. In tropical countries where wood-destroying insects and fungi are so abundant and develop so rapidly, there is always a risk to a tree when the wood is exposed, and one of the main uses of the rubbers, dammers, wood-oils and other such excretions is to prevent the intrusion of such enemies into accidental wounds, by sealing them up as soon as the wound is made. It would be easy however, when necessary to make and apply some such disinfectant as above suggested to protect the exposed wood till the bark has grown over the cut again.

"Kickxia when treated judiciously yields between $\frac{3}{4}$ and a pound of rubber for every year of its age, that is a tree 12 years old could be safely depended on to yield nine pounds of rubber. A pound of Kickxia rubber should realise at least 2*s*. 9*d*." This is a larger return than we expect from Hevea, although the rapidity of growth of the latter appears to be much greater than that of Kickxia. We have at present no details as to the rapidity of growth of the African plant, which I should judge from the behaviour of the few plants in the Botanic Gardens, is not what could be called a very slow grower.

Since writing the above further investigations into the various species of Kickxia has been published by P. PREUSS in the Notizblatt des Kgl. Bot. Gartens No. 19, July 1899; where it is shown that it is not *Kickxia Africana* but a new species *K. elastica* which supplies the Kickxia rubber. This plant has not yet been introduced.

INJURIOUS FUNGI.

A very troublesome fungus occurs on the leaves of clove trees which appears to have been overlooked. There appear on the leaves at first dark red spots on the under side which eventually attain a diameter of $\frac{1}{8}$ to $\frac{1}{4}$ inch, and can be seen on the upper surface as a dark blotch. Later the fructification appears on the under surface, it is white and remembles mildew at first sight. The leaves perish and fall, and as large numbers are affected the tree soon has a miserable half leafless appearance. At the same time the shoots become black and die, other shoots are produced but they too wither up, and eventually the tree becomes quite leafless and dies.

Some trees attacked by this fungus were treated with Bodeaux mixture, *viz*., Copper sulphate and lime in water. This was sprinkled on the trees by means of an ordinary garden syringe which however did not prove a very satisfactory instrument as it was difficult to spray satisfactorily the under sides of the leaves where the fungus was fruiting. The mixture did not injure the leaves in any way, and now, some months after, the trees appear more free from the fungus.

Rosellinia radiciperda, MASSEE.—This is a most destructive fungus which I recently found in a portion of the shrubbery in the Botanic Gardens. It was observed that all the plants of whatever kind growing beneath a large fig-tree, *Ficus dubia*,

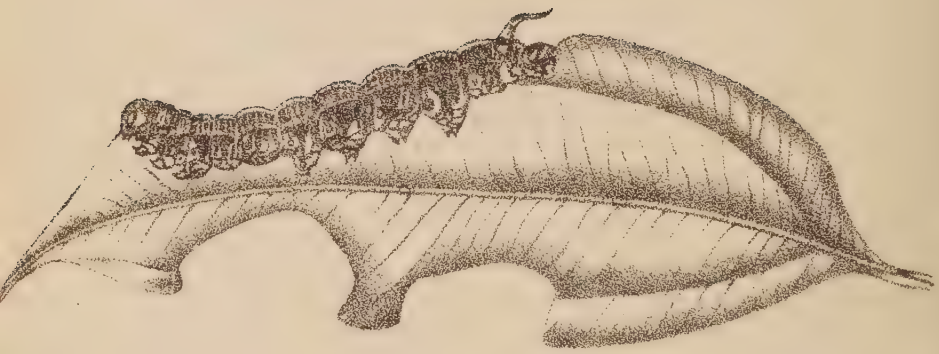
were dying suddenly with just such an appearance as if some poisonous liquid had been thrown upon them. It was at first suspected that some weed-killer had accidently been thrown there, but the patch of dying plants increased to an area of about ten yards and the roots and base of the stem of the fig-tree became black, and some months after the attack commenced the fructification of the fungus was found on the roots of the fig-tree, now quite rotten, and on other shrubs and trees in the affected area. Hardly did one plant of any kind escape attack, trees, shrubs, ferns, rattans and other palms, dracaenas and aroids went down before this pest. The succulent Dieffenbachias alone seemed to defy it and even one of those was affected. The fungus attacked the roots first, and soon appeared as a black sooty substance on the stem at the base just above and below the ground, the leaves dropped, turned of a pale greenish colour, and the plant was dead. The fructification appears as round globose black pustules about as big as snipe-shot covered with warts and densely crowded together. To extirpate the pest the ground was first cleared of all dead or dying plants, rotten wood, sticks, etc., all the affected roots of the fig-tree were cut off, and all the infected material burnt, the ground was then dug over and lime liberally strewed about and dug in. Bordeaux mixture (Copper sulphate and lime in water) was liberally poured over the base of the fig-tree, and over the ground. The disease seemed to be checked at once, it spread no further, and some small trees which had been attacked but not killed recovered. The fig-tree put out new roots and seems none the worse.

White Nutmegs.—In two valuable papers on the Nutmeg (De Noot Muskaat Cultur in de Minahassa, and De la Dehiscence du fruit du Muscadier, published at Buitenzorg) Mr. J. M. Janse treats of the so-called white nutmeg disease, which he attributes to the attacks of a fungus forming the brown spots on the husk referred to in Bulletin No. 6, p. 105, and not to imperfect fertilization as I suggested. This fungus belongs to the *Melanconieæ Phragmosporæ* and he explains its action in this manner. The fungus causes the premature dehiscence of the fruit because it uses itself a part of the nutritive matters which ought to serve for the nourishment of the pericarp. The alimentation being defective, the valves cannot grow as fast as usual. The tension between the seed and husk increases more rapidly in the diseased fruit than in the sound one, and causes the splitting of the husk prematurely. This being so, planters will find it necessary to pay some attention to the spotting of the husk, and to destroy infected fruits as speedily as possible.

Termes Gestroi.

Note.—Since writing the paragraph on this destructive Termite, I have had a large tree six inches through attacked by this pest. The tree was a marking-nut, *Semecarpus Anacardium*. It was treated by syringing with Jeyes' fluid, without removing the crust of earth with which the termites had encrusted the

A



B

C

E

F

G

×2

D

× 2

bark. This was done twice at intervals of about a fortnight, and the termites quite disappeared after the second syringing, and the tree has recovered and flowered well afterwards. This plan might also be tried in the case of rubber trees attacked, but it will be remembered that Jeye's fluid has a strong effect on leaves and tender plants, and care must be taken in its use.

Plate II.

A. Coffee Hawk moth (*Cephonodes Hylas*) natural size.
B. Caterpillar of the same.
C. Bug found destroying the caterpillars.
D. Banana Weevil, *Sphenophorus sordidus*, enlarged twice.
E. Larva, enlarged twice.
F. Pupa, ,,
G. Red Banana Weevil, *Sphenophorus planipennis*, enlarged twice.